Founded 1874—Fifty-One Years of Service

Electrical World

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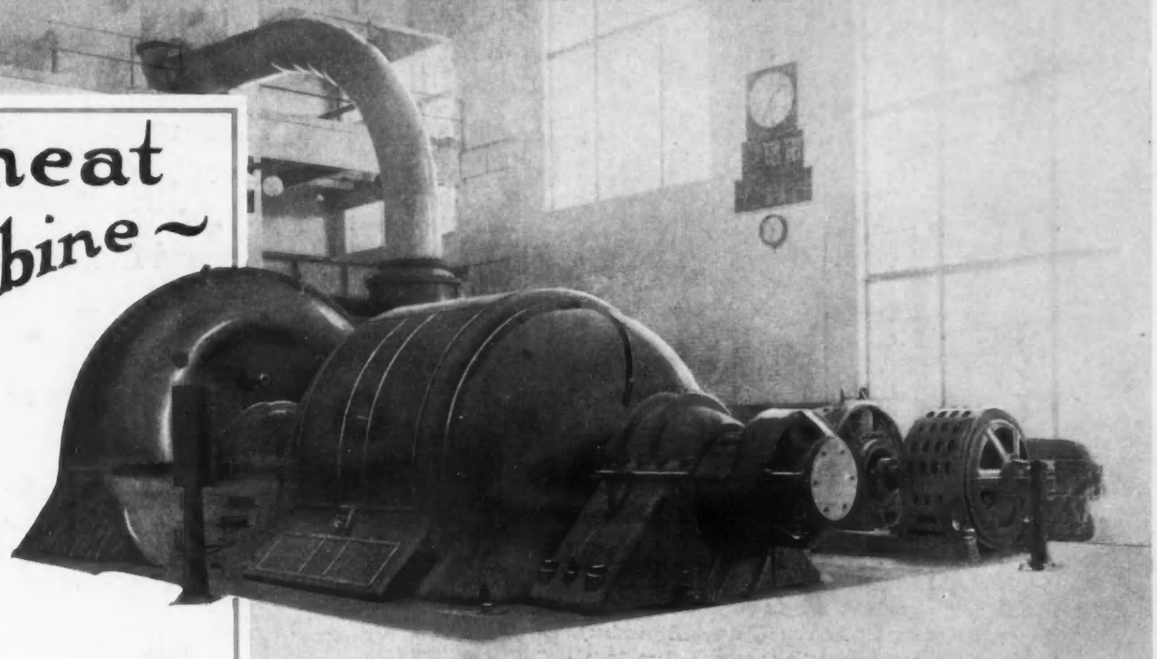
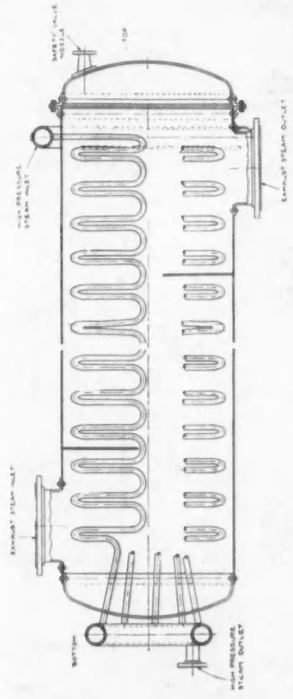


Reheat at the Turbine ~



THE necessity of economies in power production has led to the use of new methods and new equipment.

Having the steam superheated during the whole period of expansion in a turbine has many thermal advantages. To accomplish this, the steam must be reheated after it has passed through a number of stages having its pressure and temperature reduced.

The Superheater Company, 17 East 42nd Street, New York, has developed an equipment that makes it possible to reheat steam with simplicity in operation, perfect regulation under load changes and low cost of installation.

This method is based on the principle that low pressure steam is most advantageously reheated by high pressure live steam, where the latent heat of the live steam is utilized. It eliminates large low pressure pipe lines between turbine and boiler, complicated superheater arrangements and uses the two best heating agencies: Steam and Elesco.

For further particulars write for Bulletin DT-17.

ELESCO

A Quality Group of Portable Instruments

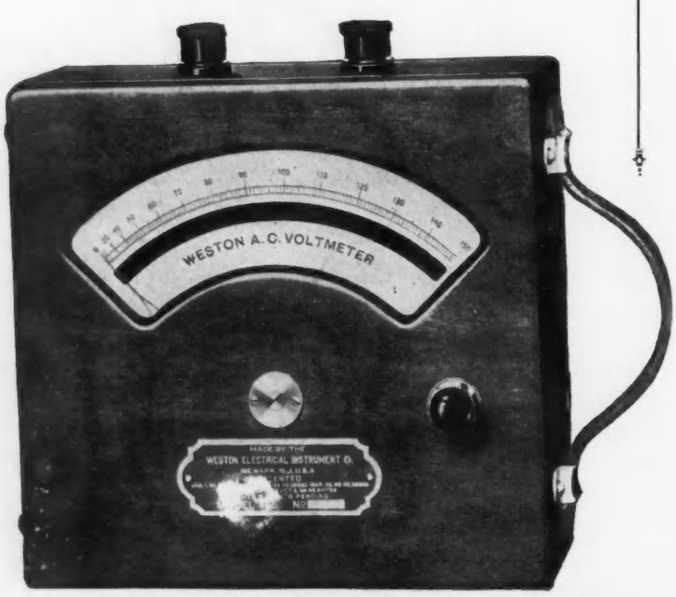
THIS model is supplied in seventeen ranges as voltmeters, seventeen ranges as ammeters and five ranges as milliammeters,—just one example of the complete coverage of needs in Weston Instruments of one type.

Every field of electrical endeavor is supplied with its types and models of Weston instruments.

Leading technicians responsible for accurate performance testing in all sorts of field and laboratory work prefer Weston Instruments for their truth-telling readings, and their continued rugged precision.

WESTON MODEL 155
VOLTMETER

Portable and dustproof, of exceptionally light weight (4½ pounds) and compact in size (7 x 8⅛ x 3¼ inches) Electromagnetic or movable iron type, with zero-adjusting device.



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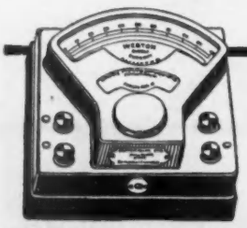

STANDARD THE WORLD OVER

WESTON

Pioneers since 1888

Table I—Data on Ou
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Line Number	COMPANY	Rank in 1924	1924					1923			
			Peak Load Kw. (Instantaneous)	Peak Load (Est. Over Thirty Minute Period) Kw.	Date of Instantaneous Peak	Output for Year Kw.-hr.	Average Load in 1924 Kw.	Peak Load Kw.	Peak Load (Est. Over Thirty Minute Period) Kw.	Date of Peak	O
	United States										
1	Niagara Falls Power Company	1	.....	423,542	.....	2,858,482,674	325,419	356,515	.....	Dec. 28	
2	Commonwealth Edison Company	2	717,000	697,000	Dec. 19	2,787,090,000	317,000	624,000	624,000	Dec. 4	
3	Edison United Companies, New York*a*	3	615,283	593,727	Dec. 23	2,056,432,473	234,750	555,433	536,533	Dec. 5	
4	Pacific Gas and Electric Company	4	343,701	.....	Dec. 19	1,887,113,680	214,835	306,945	306,945	Dec. 12	
5	Southern California Edison Company	5	330,660	.....	Mar. 10	1,664,151,512	189,453	312,500	.....	Oct. 17	
6	Detroit Edison Company	6	335,800	333,400	Nov. 21	1,460,631,400	166,300	303,600	303,600	Dec. 5	
7	Philadelphia Electric Company	7	334,048	320,000	Dec. 22	1,313,297,283	154,588	299,438	289,200	Dec. 27	
8	Public Service Electric and Gas Co	8	335,689	330,000	Dec. 22	1,198,240,840	136,800	282,654	280,500	Dec. 5	
9	Montana Power Company	9	159,150	156,500	Dec. 15	1,121,245,976	127,646	156,500	156,500	July 26	
10	Duquesne Light Company	10	239,380	227,700	Dec. 16	1,093,939,801	124,538	219,500	.....	Nov. 20	
11	Southern Power Company	11	.....	287,000*b*	Dec. 16	1,054,909,770	120,000	270,800	.....	Dec. 11	
12	West Penn. System	12	.....	188,490*b*	Dec. 23	995,609,902	113,002	181,000	.....	Dec. 18	
13	Cleveland Electric Illuminating Co. (No. American Co.)	13	227,954	222,000	Dec. 10	865,079,266	98,484	187,275	184,800	Dec. 20	
14	Alabama Power Company	14	189,050*c*	185,000	Nov. 18	823,247,290	93,800	178,200	160,000	Nov. 5	
15	St. Louis-East St. Louis Group (No. American Co.)*d*	15	.....	181,172	Dec. 17-18	801,776,855	91,200	165,000	.....	Dec. 19	
16	Buffalo General Electric Company	16	174,000	169,500	Dec. 18	759,852,160	86,500	154,800	152,500	Dec. 20	
17	Utah Power and Light Company	17	105,544	.....	Dec.	749,653,000	85,500	105,452	.....	Dec.	
18	Niagara Lockport and Ontario Pwr. Co	18	.....	156,000	.....	721,454,633	.....	142,000	142,000	Dec. 13	
19	Northern States Power Company	19	156,619	152,000	Dec. 5	691,099,810	78,677	149,196	144,989	Nov. 26	
20	Brooklyn Edison Company	20	201,600	196,850	Dec. 23	684,632,824	77,941	180,000	174,000	Dec. 20	
21	Mississippi River Power Company	21	128,250*c*	120,000	June 17	677,358,697	73,754	129,400	125,000	June 5	
22	Consol. Elec. Lt. and Pwr. Co. of Baltimore	22	143,500	.....	Dec. 23	648,307,210	73,919	138,410	.....	Dec. 19	
23	Pennsylvania Power and Light Company	23	135,335	.....	Dec. 22	630,923,200	72,023	116,453	.....	Nov.	
24	Great Western Power Co. of California	24	.....	121,800*e*	Dec. 18	617,482,000	70,068	116,800	116,800	Dec. 12	
25	Puget Sound Power and Light Company	25	125,000	124,500	Dec. 19	607,067,218	69,000	124,300	124,300	Dec. 19	
26	Consumers Power Company	26	146,789	144,640	Dec. 5	602,152,714	68,559	139,849	137,052	Sept. 18	
27	Milwaukee Group (No. American Co.)*f*	27	156,179	.....	Dec. 16	595,329,699	67,800	138,291	138,291	Nov. 27	
28	San Joaquin Light and Power Corpn	28	94,150	94,000	July 9	573,821,266	56,000	73,425	73,425	July 27	
29	Edison Electric Illum. Co. of Boston	29	167,929	.....	Nov. 24	564,459,887	105,793	153,123	.....	Dec. 10	
30	New England Power Company System	30	.....	151,220*b*	Dec. 2	562,802,440	107,600*f*	139,314	.....	Oct. 23	
31	Pennsylvania Water and Power Company	31	98,200	97,000*b*	Apr. 16	487,859,000	55,500	85,000	84,400	Jan. 3	
32	Union Gas and Electric Company	32	125,200*g*	.....	Dec. 17	480,219,880	61,923	112,000	107,000	Dec. 20	
33	Tennessee Electric Power Company	33	112,500	104,800	Dec. 10	477,593,985	54,371	93,700	97,500	Mar. 5	
34	Los Angeles Bureau of Power & Light	34	101,162	99,984	Dec. 22	437,209,701	48,104	98,945	98,096	Dec. 13	
35	Public Service Co. of No. Illinois	35	115,392*g*	102,392	Dec. 5	514,065,402*h*	54,706*i*	98,017	96,943	Dec. 4	
36	Washington Water Power Company	36	91,824	78,028	Dec. 19	426,053,680	47,660	86,487	84,955	Nov. 9	
37	Ohio Public Service Company	37	121,000	110,800*b*	Dec. 3	417,544,531	47,500	92,723	.....	Dec.	
38	Adirondack Power and Light Corpn	38	.....	108,400*b*	Dec. 16	412,143,909	46,920	82,895	.....	Nov. 26	
39	Georgia Railway and Power Company	39	98,000	48,000	Nov.20-Dec.9	395,219,890	45,116	91,500	85,000	Oct. 4	
40	Portland Electric Power Company	40	.....	91,600*b*	Dec. 19*b*	394,013,720	45,000	81,500	81,800	Dec. 20	
41	Pennsylvania-Ohio Power and Light Co	41	75,000	69,000	.....	341,939,101	38,900	61,100	61,100	Jan. 19	
42	Minnesota Power and Light Company	42	.....	68,375*b*	Sept. 29	340,181,750	38,725	50,300	.....	May 22	
43	Kansas City Power and Light Co	43	.....	67,723*e*	Dec. 4*e*	315,582,737	35,925	62,800	.....	Sept. 27	
44	Penn. Public Service System	44	69,300	66,000	Dec. 16	298,707,292	34,000	57,000	48,000	Jan.	
45	North West Utilities Company	45	.....	74,431	.....	298,281,324	34,000	43,439	43,439	Sept.	
46	Narragansett Electric Lighting Co	46	.....	87,000*b*	Feb. 14	289,626,000	33,062	88,000	.....	Nov. 21	
47	Potomac Electric Power Company	47	77,000	74,000	Dec. 23	286,695,035	32,640	70,000	68,160	Dec. 27	
48	Toledo Edison Company	48	77,000	77,000	Dec. 15	279,848,936	31,900	73,000	73,000	Dec. 5	
49	Virginia Railway and Power Company	49	.....	58,950	Dec. 23	276,663,178	31,580	56,400	62,000	Dec. 18	
50	Rochester Gas and Electric Corpn	50	62,069	56,269*b*	Dec. 12	267,223,754	30,353	61,824	56,124	Dec. 6	
51	Northern Ohio Traction and Light Company	51	.....	47,400*s*	Jan. 9	267,074,055	43,150	46,400	46,400	Dec. 10	
52	Texas Power and Light Company	52	53,400	.....	Sept. 4	262,187,000	29,917	37,570	.....	Dec. 17	
53	Michigan Northern Power Company	53	.....	30,297*r*	Dec. 9*r*	258,750,604	29,457	34,510	.....	Oct. 19	
54	Fort Worth Power and Light Company	54	50,000	.....	Dec. 31	257,757,000	29,413	45,067	.....	Dec. 18	
55	Dayton Power and Light Company	55	72,000	68,000	Dec. 12	249,330,663	29,062	58,500	57,000	Dec. 10	
56	Los Angeles Gas and Electric Corpn	56	69,000	69,000	Nov. 5	245,047,430	27,883	43,500	43,500	Dec. 18	
57	Appalachian Power Company	57	50,100*b*	.....	Nov. 25*b*	244,300,000	27,820	47,800	.....	.....	
58	Turners Falls Power and Light Company	58	56,700	55,000	Nov. 8	238,574,255	27,236	59,600	59,600	June 13	
59	Connecticut Light and Power Company	59	.....	60,712	.....	227,558,428	22,602	50,900	53,450	Dec. 5	
60	Southern Sierras Power Company *j*	60	40,500	.....	June 7-Oct. 21	226,680,958	25,806	40,100	.....	June 11	
61	New Orleans Public Service Company	61	56,000	55,000	Dec. 12	226,584,380	26,000	51,700	.....	Dec.	
62	Columbus Railway, Power and Light Company	62	50,400	.....	Dec. 4	218,909,400	24,900	53,200	53,200	Nov. 23	
63	Idaho Power Company	63	48,238	.....	May	218,464,000	24,939	40,016	.....	Aug.	
64	Public Service Company of Colorado System	64	55,000	52,000	Dec. 22	216,151,037	24,600	.....	.....	Dec.	
65	Central Illinois Public Service Company	65	53,500	53,500	Dec. 30	202,871,998	22,100	42,300	42,300	Sept. 5	
66	Metropolitan Edison Company	66	56,500	52,000	Dec. 17	194,606,000	35,000	41,600	41,000	Dec.	
67	Birmingham Electric Company	67	37,749	.....	Dec. 10	193,987,141	22,144	35,202	.....	Dec. 5	
68	American Public Utilities Company	68	55,000	48,426	Dec. 22	193,205,739	22,055	36,000	.....	Dec.	
69	Northwestern Electric Company	69	34,500*c*	33,400*b*	.....	188,771,500	20,200	30,900	31,000	Dec. 19	
70	Louisville Gas and Electric Company	70	48,700	46,800	Dec. 3	183,091,200	21,809	45,100	42,000	Dec. 4	
71	Indianapolis Light and Heat Company	71	45,544	45,544	Dec. 18	181,810,339	20,754	39,478	39,478	May 8-11	
72	California Oregon Power Company	72	36,222	36,222	Dec. 10	180,554,058	20,000	32,463	32,463	Nov. 20	
73	New York and Queens Electric Lt. & Pwr. Co.*k*	73	48,900	43,100	Dec. 23	168,403,952	19,200	40,650	39,583	Dec. 5	
74	Nebraska Power Company	74	34,700	.....	Dec. 18	166,110,700	18,961	34,000	.....	Dec. 19	
75	Penn. Central Light and Power Company	75	40,100	39,950	Dec. 30	165,364,793	18,761	36,100	35,700	Dec. 20	
76	Scranton Electric Company	76	.....	39,800	Dec. 23	164,162,797	18,700	.....	.....	.....	
77	Kansas Gas and Electric Company	77	35,200	.....	Dec.	163,783,700	18,697	33,000	.....	Dec. 3	
78	Hartford Electric Light Company	78	54,700	52,000	Nov. 19	163,178,438	18,600	60,200	58,500	Oct 23-Nov 22	
79	Houston Lighting and Power Company	79	33,100	.....	Nov. 25	161,307,120	18,528	27,400	.....	Dec. 3	
80	Columbus Electric and Power Company	80	38,910	.....	Dec. 5	156,732,805	34,010*l*	36,310	36,310	Oct. 16	
81	Central Maine Power Company	81	.....	33,300*b*	.....	154,117,396	17,550	32,200	.....	Dec. 3	
82	Seattle Municipal Light and Power Co	82	50,800	49,500	Dec. 9	152,125,000	17,250	35,600	34,500	Dec. 7	
83	Northern Indiana Gas and Electric Co	83	28,800*p*	.....	Dec. 23*q*	149,220,978	17,000	.....	.....	.....	
84	Empire District Electric Company	84	41,200	.....	Dec. 17	148,402,996	17,143	58,826	.....	May	
85	Virginian Power Company	85	50,500	47,000	Mar. 10	148,012,957	17,800	47,645	.....	Dec.	
86	City of Tacoma Light Department	86	.....	.....	.....	.....	.....	.....	.....	.....	

Output and Peak Load of Largest Genera Companies in the United States and Canad

These data include all lighting, power and electric railway companies in the United States and Canada having yearly output in excess of 100,000,000 kw.-hr. during 1924

1923			1922			1921			1920			1919		
Date of Peak	Output for Year Kw.-hr.	Average Load During 1923 Kw.	Peak Load Kw.	Date of Peak Load	Output for Year Kw.-hr.	Peak Load Kw.	Date of Peak Load	Output for Year Kw.-hr.	Peak Load Kw.	Date of Peak Load	Output for Year Kw.-hr.	Peak Load Kw.	Date of Peak Load	Output for Y Kw.-hr.
Dec. 28	2,595,847,000	296,329	328,826	Nov. 23	2,252,249,000	298,120	Dec. 22	1,855,120,000	303,640	Apr. 29	2,328,326,064	275,803	Dec. 29	2,034,608,9
Dec. 4	2,573,286,711	293,756	600,000	Dec. 12	2,225,442,875	525,640	Dec. 21	1,928,271,943	478,820	Dec. 17	1,883,570,000	428,630	Dec. 15	1,628,340.0
Dec. 5	1,899,679,975	217,000	497,577	Dec. 20	1,659,269,781	422,721	Dec. 14	1,475,276,053	398,535	Dec. 6 and 22	1,383,070,086	330,210	Nov. 25	1,104,521,8
Dec. 12	1,725,619,492	196,989	293,708	Nov. 10	1,608,940,735	265,925	Nov. 29	1,489,088,657	259,004	Dec. 22	1,475,678,673	187,135	Dec. 19	994,557,4
Oct. 17	1,548,896,120	173,248	239,160	Aug. 28	1,198,926,369	238,480	Dec. 13	1,224,718,196	213,450	July 12	1,079,474,091	200,020	July 23	1,021,977,5
Dec. 5	1,360,017,300	155,300	254,700	Dec. 7	1,105,211,100	201,500	Nov. 23	897,980,200	218,800	June 16	1,002,306,000	210,000	Dec. 5	872,583,2
Dec. 27	1,148,511,101	135,785	260,355	Dec. 14	956,910,225	213,570	Dec. 8	877,047,595	203,624	Nov. 23	910,327,693	199,247	Dec. 18	722,615,2
Dec. 5	1,084,990,294	122,700	249,778	Dec. 18	958,407,194	213,502	Nov. 28	821,198,975	216,452	Nov. 16	912,899,972	207,890	Dec. 16	821,355,2
July 26	1,122,750,450	128,168	135,600	Aug. 10	963,662,660	116,600	Jan. 11	572,277,989	159,700	Aug. 7	1,103,620,644	133,500	June 13	865,998,5
Nov. 20	1,063,046,267	119,477	208,980	Dec. 13	858,329,336	164,240	Feb. 1	702,897,985	162,000	Jan. 29	810,401,406	157,900	Dec. 22	623,000,0
Dec. 11	1,001,026,319	114,272	233,000	July	910,488,432	218,300	Feb.	790,000,000	210,000	Nov.	745,873,992	196,500	Dec.	585,596,9
Dec. 18	945,691,000	108,000	137,354	Dec. 11	634,674,505	106,919	Dec. 21	516,829,636	104,618	Nov. 24	524,976,000	.....	.....	.....
Dec. 20	802,859,991	91,651	181,112	Dec. 14	688,149,162	141,850	Dec. 15	564,819,267	155,041	Sept. 9	682,557,097	153,878	Dec. 5	576,131,6
Nov. 5	763,260,963	87,100	153,100	Dec. 18	607,133,242	115,500	Dec. 20	232,991,540	97,900	Sept. 28	488,089,061	83,100	Jan. 10	347,993,2
Dec. 19	753,903,290	74,237	134,100	Nov. 27	554,551,123	116,275	Dec. 9	508,893,262	105,749	Dec. 21	471,611,047	99,498	Dec. 3	408,920,5
Dec. 20	707,958,270	80,800	142,000	Dec. 7	587,682,340	115,000	Nov. 14	479,862,700	108,500	Oct. 26	544,293,410	106,500	Nov. 22	508,583,6
Dec.	621,977,000	71,000	87,158	Dec. 19	428,962,903	75,661	Jan. 8	362,908,000	85,404	Nov.	519,854,000	79,725	Jan. 14	461,532,0
Dec. 13	707,087,842	80,718	127,000	Nov. 24	552,035,090	87,000	Nov. 2	415,153,634	88,000	Jan. 6	492,466,460	.....	.....	.....
Nov. 26	636,428,456	72,652	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Dec. 20	598,808,757	68,357	164,495	Dec. 7	516,987,870	137,800	Dec. 6	438,887,775	116,500	Nov. 30	382,963,027	105,400	Jan. 15	327,084,07
June 5	632,715,867	72,228	122,300	June 14	619,837,527	117,450	Nov. 28	602,580,980	115,650	Nov. 13	644,163,000	113,450	Nov. 18	590,488,0
Dec. 19	678,346,746	77,437	138,800	Dec. 13	568,669,404	108,330	Nov. 30	415,335,614	88,990	Nov. 30	429,710,847	80,640	Dec. 5	392,201,2
Nov.	602,691,800	68,800	106,987	Nov. 14	495,344,612	84,203	Sept. 27	442,507,974	87,685	Sept.	411,639,501	.....	.....	.....
Dec. 12	589,597,024	65,673	105,910	Dec. 5	572,693,958	95,540	June 7	490,584,257	80,600	July 27	408,577,754	84,860	Aug. 1	453,353,3
Dec. 19	577,578,440	65,933	105,600	Dec. 4	474,042,886	99,800	Dec. 1	419,197,581	95,725	Dec. 3	472,765,800	93,900	Dec. 18	452,209,0
Sept. 18	574,031,472	65,529	116,130	Dec. 4	461,840,561	95,410	Dec. 12	397,815,027	106,924	May 19	476,095,098	108,847	Nov. 28	456,230,1
Nov. 27	553,624,392	63,427	134,482	Dec. 19	458,405,215	98,887	Nov. 22	375,354,892	90,347	Jan. 6	398,619,744	97,912	Dec. 4	331,874,1
July 27	465,458,706	53,154	67,885	Aug. 4	451,390,040	61,700	June 27	396,174,690	47,180	Aug. 28	299,536,000	.....	.....	.....
Dec. 10	526,465,178	60,099	133,594	Dec. 14	439,448,099	128,200	Dec. 15	375,025,955	105,090	Dec. 9	395,076,738	103,136	Dec. 8	328,798,8
Oct. 23	575,067,581	65,647	125,460	Dec. 14	469,993,180	112,200	Nov. 9	405,979,457	103,450	Jan. 6	430,918,000	93,860	Dec. 9	357,303,2
Jan. 3	420,028,600	47,900	83,000	June 10	373,341,800	83,000	Nov.	419,987,000	85,000	.....	494,624,400	87,000	Nov.	512,138,1
Dec. 20	438,386,388	50,044	100,000	Dec. 13	366,071,350	75,000	Dec. 14 & 23	281,537,273	65,050	Dec. 21	234,634,375	.....	.....	.....
Mar. 5	460,097,505	52,500	82,700	Dec. 11	353,320,559	69,100	May 16	342,948,926	74,800	Apr. 3 & June 4	482,649,835	82,300	Feb. 14	422,272,5
Dec. 13	426,337,964	48,669	75,275	Dec. 15	318,502,702	51,900	Dec. 21	300,353,806	46,500	Dec. 29	169,489,210	.....	.....	.....
Dec. 4	427,460,666	48,797	82,737	Dec. 19	362,220,201	80,563	Dec. 30	415,940,095	.....	.....	.....	.....	.....	.....
Nov. 9	413,240,900	46,487	89,278	Dec. 12	407,657,100	70,110	Nov. 23	374,378,300	63,955	Jan. 21	351,087,900	63,220	Dec. 3	241,761,3
Dec.	415,424,787	47,423	80,080	Nov.	316,838,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
Nov. 26	380,630,188	43,451	81,100	Dec. 14	304,997,551	61,500	Dec. 21	243,370,354	60,700	Dec. 2	277,100,000	39,500	Dec. 23	144,553,0
Oct. 4	358,353,618	40,800	80,000	Nov. 15	317,068,699	72,000	Nov. 3 & 28	282,084,977	76,000	Apr. 9	293,721,290	71,700	Dec. 18	262,834,5
Dec. 20	365,997,750	41,780	71,800	Dec. 28	324,116,190	64,800	Dec. 20	298,514,571	62,600	Dec. 6	292,318,971	56,300	Dec. 22	271,600,3
Jan. 19	340,864,488	38,911	64,200	Nov. 20	276,936,464	45,300	Nov. 9	202,670,200	48,900	Nov. 3	255,537,150	.....	.....	.....
May 22	251,144,646	28,950	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sept. 27	289,903,699	34,450	59,490	Dec. 6	253,305,000	50,531	Dec. 23	204,752,604	35,500	Dec. 23	175,939,618	.....	.....	.....
Jan.	182,281,000	20,808	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sept.	203,997,334	23,287	43,589	Dec.	163,902,506	31,885	Apr.	132,788,852	.....	.....	.....	.....	.....	.....
Nov. 21	373,505,000	42,638	85,000	Dec. 4	297,400,000	72,000	Nov. 23	243,087,000	54,000	Jan. 5 & Nov. 6	213,232,000	57,000	Dec. 23	155,678,8
Dec. 27	269,870,850	30,807	70,000	Dec. 20	251,984,618	65,000	Dec. 14	238,028,571	62,000	Nov. 30	225,994,701	55,000	Dec. 17	204,008,6
Dec. 5	273,643,372	31,238	58,000	Dec. 14	215,785,945	46,700	Dec. 13	179,121,428	52,400	Mar.	207,830,610	48,220	Dec.	199,771,7
Dec. 18	262,940,313	30,000	54,250	Dec. 18	230,293,745	47,000	Dec. 14	208,323,000	46,150	Dec. 22	208,517,000	42,800	Dec. 18	125,840,0
Dec. 6	248,156,900	28,330	53,040	Nov. 23	193,503,573	48,734	Dec. 16	185,480,692	49,400	Oct. 29	193,601,590	42,500	Dec. 2	172,892,2
Dec. 10	259,720,216	29,100	43,000	Dec.	232,684,874	42,000	Oct. 12	187,249,647	44,400	May	247,109,963	.....	.....	.....
Dec. 17	225,453,000	25,736	66,560	Dec. 13	183,536,613	33,620	Sept. 22	156,851,213	33,620	Oct. 14	159,939,831	.....	.....	.....
Oct. 19	261,577,017	29,860	32,449	Nov. 3	246,175,203	35,018	Aug. 14	258,249,673	35,408	Nov. 12	257,752,195	35,794	Apr. 23	264,272,4
Dec. 18	240,662,700	27,472	38,500	Dec. 21	178,790,374	29,500	Oct. 15	163,286,500	.....	.....	.....	.....	.....	.....
Dec. 10	196,615,340	22,444	46,500	Dec. 8	159,836,687	37,500	Nov. 28	134,588,457	31,500	May 25 & Sept 28	129,618,270	.....	.....	.....
Dec. 18	127,357,201	14,563	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	244,600,000	27,900	42,600	Dec. 4	205,447,368	35,600	Dec. 19	154,500,000	35,300	Oct.	148,700,000	.....	.....	.....
June 13	217,138,000	24,800	56,400	May 16	201,796,000	57,900	May 17	170,826,000	55,500	May 27	212,126,530	.....	.....	.....
Dec. 5	196,432,892	22,400	45,706	Dec. 14	158,371,247	28,255	Nov. 28	101,129,915	33,392	Oct. 12	145,111,822	.....	.....	.....
June 11	219,653,900	25,011	36,200	July 14	186,671,850	45,700	June 6 & Aug. 8	199,452,965	32,600	July 23	175,104,808	29,200	.....	165,782,7
Dec.	211,765,420	24,174	46,500	Dec. 13	188,000,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
Nov. 23	231,641,760	26,443	52,100	Dec. 14	187,785,967	38,440	Dec. 12	160,423,240	.....	.....	153,626,000	.....	.....	.....
Aug.	222,590,000	25,410	38,323	July 24	212,237,000	35,635	Sept. 1	190,215,255	34,235	July	184,843,000	.....	.....	.....
Dec.	145,302,874	16,587	28,800	Dec.	102,631,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sept. 5	174,670,219	19,941	30,800	Oct.	128,345,120	26,300	Dec.	114,587,986	.....	.....	.....	.....	.....	.....
Dec.	168,814,810	19,271	32,100	Nov. 20	127,315,007	27,900	Nov. 30	99,815,200	28,000	Aug. 10	133,994,030	.....	.....	.....
Dec. 5	162,443,207	18,544	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Dec.	148,000,000	16,895	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Dec. 19	152,702,800	17,411	22,700	Dec. 29	120,698,840	22,190	Dec. 12	113,913,335	20,600	Dec. 10	112,736,089	.....	.....	.....
Dec. 4	160,754,592	19,201	39,500	Dec. 13	136,850,900	32,500	Dec. 7	112,472,748	.....	.....	.....	.....	.....	.....
May 8-11	169,453,319	19,350	38,326	Dec. 14	138,356,280	29,350	Nov. 9	108,829,278	27,240	Sept. 15	114,416,090	.....	.....	.....
Nov. 20	153,500,531	17,523	27,695	Dec. 20	131,293,165	20,270	Mar. 16	133,091,607	20,335	Jan. 28	143,025,818	.....	.....	.....
Dec. 5	143,749,060	16,409	35,300	Nov. 15	120,011,093	.....	.....	.....	.....	.....	.....	.....	.....	.....
Dec. 19	160,624,600	18,335	30,200	Dec. 6	140,272,500	28,200	Oct. 25	127,758,800	25,500	Nov. 26	114,200,500	.....	.....	.....
Dec. 20	147,423,930	16,890	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Dec. 3	160,464,200	18,300	29,600	Dec. 7	139,167,200	25,000	Dec.	130,479,900	.....	.....	.....	.....	.....	.....
Oct 23-Nov 22	181,202,880	20,685	56,000	Dec. 14	134,000,000	31,700	Nov. 14	97,754,000	32,500	Jan. 9	103,000,000	.....	.....	.....
Dec. 3	129,318,120	14,762	24,200	Nov. 22	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oct. 16	160,246,106	18,293	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Dec. 3	146,136,310	16,700	32,500	Dec. 11	128,445,449	.....	.....	.....	.....	.....	.....	.....	.....	.....
Dec. 7	115,431,550	13,150	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
May	152,681,540	17,400	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Dec.	163,147,137	18,624	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Output and Peak Load of Largest Generat
Companies in the United States and Canad

These data include all lighting, power and electric railway companies in the United States and Canada having yearly output in excess of 100,000,000 kw.-hr. during 1924

23			1922			1921			1920			1919		
e of k	Output for Year Kw.-hr.	Average Load During 1923 Kw.	Peak Load Kw.	Date of Peak Load	Output for Year Kw.-hr.	Peak Load Kw.	Date of Peak Load	Output for Year Kw.-hr.	Peak Load Kw.	Date of Peak Load	Output for Year Kw.-hr.	Peak Load Kw.	Date of Peak Load	Output for Year Kw.-hr.
28	2,595,847,000	296,329	328,826	Nov. 23	2,252,249,000	298,120	Dec. 22	1,855,120,000	303,640	Apr. 29	2,328,326,064	275,803	Dec. 29	2,034,608,904
4	2,573,286,711	293,756	600,000	Dec. 12	2,225,442,875	525,640	Dec. 21	1,928,271,943	478,820	Dec. 17	1,883,570,000	428,630	Dec. 15	1,628,340,000
5	1,899,679,975	217,000	497,577	Dec. 20	1,659,269,781	422,721	Dec. 14	1,475,276,053	398,535	Dec. 6 and 22	1,383,070,086	330,210	Nov. 25	1,104,521,883
12	1,725,619,492	196,989	293,708	Nov. 10	1,608,940,735	265,925	Nov. 29	1,489,088,657	259,004	Dec. 22	1,475,678,673	187,135	Dec. 19	994,557,418
17	1,548,896,120	173,248	239,160	Aug. 28	1,198,926,369	238,480	Dec. 13	1,224,718,196	213,450	July 12	1,079,474,091	200,020	July 23	1,021,977,519
5	1,360,017,300	155,300	254,700	Dec. 7	1,105,211,100	201,500	Nov. 23	897,980,200	218,800	June 16	1,002,306,000	210,000	Dec. 5	872,583,200
27	1,148,511,101	135,785	260,355	Dec. 14	956,910,225	213,570	Dec. 8	877,047,595	203,624	Nov. 23	910,327,693	199,247	Dec. 18	722,615,280
5	1,084,990,294	122,700	249,778	Dec. 18	958,407,194	213,502	Nov. 28	821,198,975	216,452	Nov. 16	912,899,972	207,890	Dec. 16	821,355,239
26	1,122,750,450	128,168	135,600	Aug. 10	963,662,660	116,600	Jan. 11	572,277,989	159,700	Aug. 7	1,103,620,644	133,500	June 13	865,998,552
20	1,063,046,267	119,477	208,980	Dec. 13	858,329,336	164,240	Feb. 1	702,897,985	162,000	Jan. 29	810,401,406	157,900	Dec. 22	623,000,000
11	1,001,026,319	114,272	233,000	July	910,488,432	218,300	Feb.	790,000,000	210,000	Nov.	745,873,992	196,500	Dec.	585,596,925
18	945,691,000	108,000	137,354	Dec. 11	634,674,505	106,919	Dec. 21	516,829,636	104,618	Nov. 24	524,976,000	.....	.....	.....
20	802,859,991	91,651	181,112	Dec. 14	688,149,162	141,850	Dec. 15	564,819,267	155,041	Sept. 9	682,557,097	153,878	Dec. 5	576,131,649
5	763,260,963	87,100	153,100	Dec. 18	607,133,242	115,500	Dec. 20	232,991,540	97,900	Sept. 28	488,089,061	83,100	Jan. 10	347,993,284
19	753,903,290	74,237	134,100	Nov. 27	554,551,123	116,275	Dec. 9	508,893,262	105,749	Dec. 21	471,611,047	99,498	Dec. 3	408,920,575
20	707,958,270	80,800	142,000	Dec. 7	587,682,340	115,000	Nov. 14	479,862,700	108,500	Oct. 26	544,293,410	106,500	Nov. 22	508,583,680
	621,977,000	71,000	87,158	Dec. 19	428,962,903	75,661	Jan. 8	362,908,000	85,404	Nov.	519,854,000	79,725	Jan. 14	461,532,000
13	707,087,842	80,718	127,000	Nov. 24	552,035,090	87,000	Nov. 2	415,153,634	88,000	Jan. 6	492,466,460	.....	.....	.....
26	636,428,456	72,652	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	598,808,757	68,357	164,495	Dec. 7	516,987,870	137,800	Dec. 6	438,887,775	116,500	Nov. 30	382,963,027	105,400	Jan. 15	327,084,075
5	632,715,867	72,228	122,300	June 14	619,837,527	117,450	Nov. 28	602,580,980	115,650	Nov. 13	644,163,000	113,450	Nov. 18	590,488,000
19	678,346,746	77,437	138,800	Dec. 13	568,669,404	108,330	Nov. 30	415,335,614	88,990	Nov. 30	429,710,847	80,640	Dec. 5	392,201,280
	602,691,800	68,800	106,987	Nov. 14	495,344,612	84,203	Sept. 27	442,507,974	87,685	Sept.	411,639,501	.....	.....	.....
12	589,597,024	65,673	105,910	Dec. 5	572,693,958	95,540	June 7	490,584,257	80,600	July 27	408,577,754	84,860	Aug. 1	453,353,358
19	577,578,440	65,933	105,600	Dec. 4	474,042,886	99,800	Dec. 1	419,197,581	95,725	Dec. 3	472,765,800	93,900	Dec. 18	452,209,000
18	574,031,472	65,529	116,130	Dec. 4	461,840,561	95,410	Dec. 12	397,815,027	106,924	May 19	476,095,098	108,847	Nov. 28	456,230,164
27	553,624,392	63,427	134,482	Dec. 19	458,405,215	98,887	Nov. 22	375,354,892	90,347	Jan. 6	398,619,744	97,912	Dec. 4	331,874,192
27	465,458,706	53,154	67,885	Aug. 4	451,390,040	61,700	June 27	396,174,690	47,180	Aug. 28	299,536,000	.....	.....	.....
10	526,465,178	60,099	133,594	Dec. 14	439,448,099	128,200	Dec. 15	375,025,955	105,090	Dec. 9	395,076,738	103,136	Dec. 8	328,798,850
23	575,067,581	65,647	125,460	Dec. 14	469,993,180	112,208	Nov. 9	405,979,457	103,450	Jan. 6	430,918,000	93,860	Dec. 9	357,303,224
3	420,028,600	47,900	83,000	June 10	373,341,800	83,000	Nov.	419,987,000	85,000	.....	494,624,400	87,000	Nov.	512,138,100
20	438,386,388	50,044	100,000	Dec. 13	366,071,350	75,000	Dec. 14 & 23	281,537,273	65,050	Dec. 21	234,634,375	.....	.....	.....
5	460,097,505	52,500	82,700	Dec. 11	353,320,559	69,100	May 16	342,948,926	74,800	Apr.3&June4	482,649,835	82,300	Feb. 14	422,272,590
13	426,337,964	48,669	75,275	Dec. 15	318,502,702	51,900	Dec. 21	300,353,806	46,500	Dec. 29	169,489,210	.....	.....	.....
4	427,460,666	48,797	82,737	Dec. 19	362,220,201	80,563	Dec. 30	415,940,095	.....	.....	.....	.....	.....	.....
9	413,240,900	46,487	89,278	Dec. 12	407,657,100	70,110	Nov. 23	374,378,300	63,955	Jan. 21	351,087,900	63,220	Dec. 3	241,761,350
	415,424,787	47,423	80,080	Nov.	316,838,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
26	380,630,188	43,451	81,100	Dec. 14	304,997,551	61,500	Dec. 21	243,370,354	60,700	Dec. 2	277,100,000	39,500	Dec. 23	144,553,094
4	358,353,618	40,800	80,000	Nov. 15	317,068,699	72,000	Nov. 3 & 28	282,084,977	76,000	Apr. 9	293,721,290	71,700	Dec. 18	262,834,541
20	365,997,750	41,780	71,800	Dec. 28	324,116,190	64,800	Dec. 20	298,514,571	62,600	Dec. 6	292,318,971	56,300	Dec. 22	271,600,300
19	340,864,488	38,911	64,200	Nov. 20	276,936,464	45,300	Nov. 9	202,670,200	48,900	Nov. 3	255,537,150	.....	.....	.....
22	251,144,646	28,950	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
27	289,903,699	34,450	59,490	Dec. 6	253,305,000	50,531	Dec. 23	204,752,604	35,500	Dec. 23	175,939,618	.....	.....	.....
	182,281,000	20,808	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	203,997,334	23,287	43,589	Dec.	163,902,506	31,885	Apr.	132,788,852	.....	.....	.....	.....	.....	.....
21	373,505,000	42,638	85,000	Dec. 4	297,400,000	72,000	Nov. 23	243,087,000	54,000	Jan.5&Nov.6	213,232,000	57,000	Dec. 23	155,678,890
27	269,870,850	30,807	70,000	Dec. 20	251,984,618	65,000	Dec. 14	238,028,571	62,000	Nov. 30	225,994,701	55,000	Dec. 17	204,008,647
5	273,643,372	31,238	58,000	Dec. 14	215,785,945	46,700	Dec. 13	179,121,428	52,400	Mar.	207,830,610	48,220	Dec.	199,771,799
18	262,940,313	30,000	54,250	Dec. 18	230,293,745	47,000	Dec. 14	208,323,000	46,150	Dec. 22	208,517,000	42,800	Dec. 18	125,840,000
6	248,156,900	28,330	53,040	Nov. 23	193,503,573	48,734	Dec. 16	185,480,692	49,400	Oct. 29	193,601,590	42,500	Dec. 2	172,892,249
10	259,720,216	29,100	43,000	Dec.	232,684,874	42,000	Oct. 12	187,249,647	44,400	May	247,109,963	.....	.....	.....
17	225,453,000	25,736	66,560	Dec. 13	183,536,613	33,620	Sept. 22	156,851,213	33,620	Oct. 14	159,939,831	.....	.....	.....
19	261,577,017	29,860	32,449	Nov. 3	246,175,203	35,018	Aug. 14	258,249,673	35,408	Nov. 12	257,752,195	35,794	Apr. 23	264,272,468
18	240,662,700	27,472	38,500	Dec. 21	178,790,374	29,500	Oct. 15	163,286,500	.....	.....	.....	.....	.....	.....
10	196,615,340	22,444	46,500	Dec. 8	159,836,687	37,500	Nov. 28	134,588,457	31,500	May25&Sept28	129,618,270	.....	.....	.....
18	127,357,201	14,563	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	244,600,000	27,900	42,600	Dec. 4	205,447,368	35,600	Dec. 19	154,500,000	35,300	Oct.	148,700,000	.....	.....	.....
13	217,138,000	24,800	56,400	May 16	201,796,000	57,900	May 17	170,826,000	55,500	May 27	212,126,530	.....	.....	.....
5	196,432,892	22,400	45,706	Dec. 14	158,371,247	28,255	Nov. 28	101,129,915	33,392	Oct. 12	145,111,822	.....	.....	.....
11	219,653,900	25,011	36,200	July 14	186,671,850	45,700	June6&Aug.8	199,452,965	32,600	July 23	175,104,808	29,200	.....	165,782,785
	211,765,420	24,174	46,500	Dec. 13	188,000,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
23	231,641,760	26,443	52,100	Dec. 14	187,785,967	38,440	Dec. 12	160,423,240	.....	.....	153,626,000	.....	.....	.....
	222,590,000	25,410	38,323	July 24	212,237,000	35,635	Sept. 1	190,215,255	34,235	July	184,843,000	.....	.....	.....
	145,302,874	16,587	28,800	Dec.	102,631,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
5	174,670,219	19,941	30,800	Oct.	128,345,120	26,300	Dec.	114,587,986	.....	.....	.....	.....	.....	.....
	168,814,810	19,271	32,100	Nov. 20	127,315,007	27,900	Nov. 30	99,815,200	28,000	Aug. 10	133,994,030	.....	.....	.....
5	162,443,207	18,544	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	148,000,000	16,895	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
19	152,702,800	17,411	22,700	Dec. 29	120,698,840	22,190	Dec. 12	113,913,335	20,600	Dec. 10	112,736,089	.....	.....	.....
4	160,754,592	19,201	39,500	Dec. 13	136,850,900	32,500	Dec. 7	112,472,748	.....	.....	.....	.....	.....	.....
11	169,453,319	19,350	38,326	Dec. 14	138,356,280	29,350	Nov. 9	108,829,278	27,240	Sept. 15	114,416,090	.....	.....	.....
20	153,500,531	17,523	27,695	Dec. 20	131,293,165	20,270	Mar. 16	133,091,607	20,335	Jan. 28	143,025,818	.....	.....	.....
5	143,749,060	16,409	35,300	Nov. 15	120,011,093	.....	.....	.....	.....	.....	.....	.....	.....	.....
19	160,624,600	18,335	30,200	Dec. 6	140,272,500	28,200	Oct. 23	127,758,800	25,500	Nov. 26	114,200,500	.....	.....	.....
20	147,423,930	16,890	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3	160,464,200	18,300	29,600	Dec. 7	139,167,200	25,000	Dec.	130,479,900	.....	.....	.....	.....	.....	.....
v22	181,202,880	20,685	56,000	Dec. 14	134,000,000	31,700	Nov. 14	97,754,000	32,500	Jan. 9	103,000,000	.....	.....	.....
3	129,318,120	14,762	24,200	Nov. 22	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	160,246,106	18,293	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3	146,136,310	16,700	32,500	Dec. 11	128,445,449	.....	.....	.....	.....	.....	.....	.....	.....	.....
7	115,431,550	13,150	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
-	152,681,540	17,400	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

	41	Pennsylvania-Ohio Power and Light Co.	41	75,000	69,000	.....	341,939,101	38,900	61,100	61,100	Jan. 19			
							340,181,750	18,225	50,300		May 22			

rating and Distributing
nada

anada

utput for Year Kw.-hr.	1918 Peak Load Kw.	1918 Date of Peak Load	1918 Output for Year Kw.-hr.	1917 Peak Load Kw.	1917 Date of Peak Load	1917 Output for Year Kw.-hr.	1916 Peak Load Kw.	1916 Date of Peak Load	1916 Output for Year Kw.-hr.	1915 Peak Load Kw.	1915 Date of Peak Load	1915 Output for Year Kw.-hr.	Line Number
,034,608,904	254,139	Apr. 8	2,054,360,080	152,340	Aug. 1	1,188,221,770	143,360	Nov. 24	1,015,525,680	126,320	Dec. 27	899,427,550	1
,628,340,000	400,010	Dec. 2	1,508,070,000	392,330	Dec. 28	1,488,080,000	369,740	Dec. 19	1,341,964,000	337,900	Nov. 29	1,198,636,900	2
,104,521,883	286,103	Dec. 11	958,878,156	278,097	Dec. 12	954,913,584	254,824	Dec. 20	856,385,319	239,416	Dec. 6	740,873,162	3
994,557,418	166,705	June 4	922,037,604	158,272	Nov. 27	854,099,030	141,008	Dec. 19	768,304,907	139,540	Dec. 1	725,715,620	4
,021,977,519	163,125	July 12	779,758,000	166,755	Oct. 11	685,416,000	60,930	Dec. 28	299,950,513	56,625	July 13	286,985,095	5
872,583,200	172,000	Dec. 13	773,876,700	152,300	Nov. 27	672,200,600	130,200	Dec. 19	546,925,300	101,800	Dec. 17	393,129,850	6
722,615,280	166,294	Dec. 6	693,447,962	148,931	Nov. 20	600,583,589	142,260	Dec. 12	444,785,884	.....	.....	.....	7
821,355,239	185,738	Dec. 5	795,481,279	181,500	Nov. 27	734,665,649	174,000	Dec. 14	608,018,729	143,000	Dec. 10	490,684,988	8
865,998,552	157,800	Nov. 21	1,108,125,350	147,712	Jan. 11	947,732,014	149,740	Dec. 19	867,940,326	89,000	Dec. 20	489,831,218	9
623,000,000	141,000	Dec. 6	641,874,585	125,000	Nov. 9	592,575,925	101,000	Dec. 21	463,537,660	83,000	Nov. 29	347,514,317	10
585,596,925	162,600	Dec.	551,313,367	166,300	May	563,533,763	.....	.....	.....	.....	.....	.....	11
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12
576,131,649	128,319	Nov. 22	543,663,042	113,228	Nov. 27	444,735,309	84,999	Oct. 25	340,670,721	.....	.....	.....	13
347,993,284	86,850	Dec. 19	392,247,862	58,250	Nov. 14	289,715,125	40,500	Dec. 11	184,345,360	28,750	Dec. 21	123,882,040	14
408,920,575	92,000	Nov. 26	395,820,236	92,300	Dec. 6	376,891,756	88,544	Dec. 11	333,964,652	76,303	Nov. 29	308,759,186	15
508,583,680	104,100	Nov. 22	587,761,870	95,400	Dec. 6	440,596,100	65,500	Dec. 14	328,412,550	62,460	.....	273,950,000	16
461,532,000	81,313	Dec. 27	533,044,000	79,011	Dec. 21	502,183,000	68,894	Dec. 6	412,726,000	.....	.....	.....	17
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327,084,075	86,000	Dec. 11	282,424,822	78,000	Dec. 19	255,912,300	67,200	Dec. 19	233,452,500	62,000	Dec. 23	188,516,851	19
590,488,000	102,950	Mar. 8	557,200,000	86,400	Oct. 31	476,500,000	82,400	Nov. 27	393,400,000	77,300	Nov. 18	370,330,660	20
392,201,280	82,760	Nov. 7	433,196,550	69,980	Dec. 4	343,523,580	55,620	Dec. 11	249,836,310	40,580	Dec. 20	171,095,740	21
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453,353,358	75,480	Aug. 12	451,309,000	74,900	Oct. 6	457,998,635	74,100	Dec. 14	408,391,067	62,100	Nov. 15	337,264,400	23
452,209,000	88,230	Dec. 20	427,800,000	83,800	Dec. 21	396,600,000	77,030	Nov. 28	353,697,263	66,000	Dec. 30	295,766,712	24
456,230,164	98,666	Nov. 21	404,412,000	94,235		380,570,917			315,964,337	66,930	Dec.	245,300,654	25
331,874,192	87,855	Nov. 20	327,784,516	71,106	Nov. 30	275,966,740	64,170	Dec. 5	218,421,711	52,458	Nov. 19	158,089,543	26
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328,798,850	95,774	Dec. 6	293,966,604	83,966	Dec. 19	265,430,474	80,539	Dec. 12	239,557,144	72,802	Dec. 13	208,358,400	28
357,303,224	76,900	Dec. 16	323,127,784	71,500	Oct. 30	300,600,000	64,000	Dec. 12	246,000,000	49,300	Dec. 29	172,863,764	29
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512,138,100	89,000	Feb.	500,641,122	86,000	.....	516,891,000	77,000	.....	417,837,600	76,000	Dec. 12	.....	31
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422,272,590	87,800	Dec. 11	519,959,383	85,200	June 15	547,945,475	81,650	Dec. 14	483,354,162	.....	.....	.....	33
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241,761,350	33,956	Nov. 26	195,628,500	36,707	Dec. 20	188,311,100	30,440	Dec. 14	162,825,400	28,691	Jan. 20	165,913,500	36
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144,553,094	50,250	Nov.8-Jan.23	174,567,275	42,000	Dec. 7 & 14	158,570,164	41,575	Dec. 12 & 22	151,128,310	38,400	Dec. 13 & 29	128,640,000	38
262,834,541	68,000	Nov. 8	238,489,012	78,200	Apr. 24	258,607,882	72,600	Mar. 17	211,872,638	77,100	Dec. 17	179,976,596	39
271,600,300	56,900	Dec. 23	258,424,940	50,620	Dec. 31	218,086,315	47,335	Nov. 29	194,146,555	47,150	Dec. 30	186,372,553	40
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155,678,890	45,000	June 20	150,028,780	33,500	Dec. 19	113,238,441	.....	.....	.....	.....	.....	.....	45
204,008,647	48,000	Dec. 20	173,180,014	44,800	.....	140,762,646	38,600	Dec. 18	122,158,818	36,200	Nov. 30	111,082,725	46
199,771,799	40,305	Dec.	161,103,970	37,627	Dec.	162,061,232	36,428	Dec. 22	134,842,360	33,370	Dec. 31	100,168,375	47
125,840,000	35,700	Dec. 18	164,810,750	37,000	Dec. 18	153,128,026	33,900	Dec. 18	132,275,000	.....	.....	.....	48
172,892,249	52,300	Nov. 22	196,171,300	42,154	Dec. 13	162,490,264	40,250	Dec. 16	146,069,428	37,000	Dec. 15	123,401,451	49
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264,272,468	33,519	Dec. 24	233,381,654	32,990	Dec. 3	221,538,757	.....	.....	.....	.....	.....	.....	51
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165,782,785	28,200	Aug 6	161,347,690	25,900	Aug. 9	148,267,885	22,400	Apr. 28	131,084,265	20,300	July 21	114,187,385	59
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Jan. 19	340,864,488	38,911	64,200	Nov. 20	276,936,464	45,300	Nov. 9	202,670,200	48,900	Nov. 3	255,537,150	.....	.....

Line Number	COMPANY	Rank in 1924	1924 Peak Load Kw. (Instantaneous)	1924 Peak Load (Est. Over Thirty Minute Period) Kw.	1924 Date of Instantaneous Peak	1924 Output for Year Kw.-hr.	1924 Average Load in 1924 Kw.	1923 Peak Load Kw.	1923 Peak Load (Est. Over Thirty Minute Period) Kw.	1923 Date of Peak	O
41	Pennsylvania-Ohio Power and Light Co	41	75,000	69,000	.....	341,939,101	38,900	61,100	61,100	Jan. 19	
42	Minnesota Power and Light Company	42	.....	68,375*b*	Sept. 29	340,181,750	38,725	50,300	.....	May 22	
43	Kansas City Power and Light Co	43	.....	67,723*e*	Dec. 4*e*	315,582,737	35,925	62,800	.....	Sept. 27	
44	Penn. Public Service System	44	69,300	66,000	Dec. 16	298,707,292	34,000	57,000	48,000	Jan.	
45	North West Utilities Company	45	.....	74,431	.....	298,281,324	34,000	43,439	43,439	Sept.	
46	Narragansett Electric Lighting Co	46	.....	87,000*b*	Feb. 14	289,626,000	33,062	88,000	.....	Nov. 21	
47	Potomac Electric Power Company	47	77,000	74,000	Dec. 23	286,695,035	32,640	70,000	68,160	Dec. 27	
48	Toledo Edison Company	48	77,000	77,000	Dec. 15	279,848,936	31,900	73,000	73,000	Dec. 5	
49	Virginia Railway and Power Company	49	.....	58,950	Dec. 23	276,663,178	31,580	56,400	62,000	Dec. 18	
50	Rochester Gas and Electric Corpn	50	62,069	56,269*b*	Dec. 12	267,223,754	30,353	61,824	56,124	Dec. 6	
51	Northern Ohio Traction and Light Company	51	.....	47,400*s*	Jan. 9	267,074,055	43,150	46,400	46,400	Dec. 10	
52	Texas Power and Light Company	52	53,400	.....	Sept. 4	262,187,000	29,917	37,570	.....	Dec. 17	
53	Michigan Northern Power Company	53	.....	30,297*r*	Dec. 9*r*	258,750,604	29,457	34,510	.....	Oct. 19	
54	Fort Worth Power and Light Company	54	50,000	.....	Dec. 31	257,757,000	29,413	45,067	.....	Dec. 18	
55	Dayton Power and Light Company	55	72,000	68,000	Dec. 12	249,330,663	29,062	58,500	57,000	Dec. 10	
56	Los Angeles Gas and Electric Corpn	56	69,000	69,000	Nov. 5	245,047,430	27,883	43,500	43,500	Dec. 18	
57	Appalachian Power Company	57	50,100*b*	.....	Nov. 25*b*	244,300,000	27,820	47,800	.....	.....	
58	Turners Falls Power and Light Company	58	56,700	55,000	Nov. 8	238,574,255	27,236	59,600	59,600	June 13	
59	Connecticut Light and Power Company	59	.....	60,712	.....	227,558,428	22,602	50,900	53,450	Dec. 5	
60	Southern Sierras Power Company *j*	60	40,500	.....	June 7-Oct. 21	226,680,958	25,806	40,100	.....	June 11	
61	New Orleans Public Service Company	61	56,000	55,000	Dec. 12	226,584,380	26,000	51,700	.....	Dec.	
62	Columbus Railway, Power and Light Company	62	50,400	.....	Dec. 4	218,909,460	24,900	33,200	33,200	Nov. 23	
63	Idaho Power Company	63	48,238	.....	May	218,464,000	24,939	40,016	.....	Aug.	
64	Public Service Company of Colorado System	64	55,000	52,000	Dec. 22	216,151,037	24,600	.....	.....	Dec.	
65	Central Illinois Public Service Company	65	53,500	53,500	Dec. 30	202,871,998	22,100	42,300	42,300	Sept. 5	
66	Metropolitan Edison Company	66	56,500	52,000	Dec. 17	194,606,000	35,000	41,600	41,000	Dec.	
67	Birmingham Electric Company	67	37,749	.....	Dec. 10	193,987,141	22,144	35,202	.....	Dec. 5	
68	American Public Utilities Company	68	55,000	48,426	Dec. 22	193,205,739	22,055	36,000	.....	Dec.	
69	Northwestern Electric Company	69	34,500*c*	33,400*b*	.....	188,771,500	20,200	30,900	31,000	Dec. 19	
70	Louisville Gas and Electric Company	70	48,700	46,800	Dec. 3	183,091,200	21,809	45,100	42,000	Dec. 4	
71	Indianapolis Light and Heat Company	71	45,544	45,544	Dec. 18	181,810,339	20,754	39,478	39,478	May 8-11	
72	California Oregon Power Company	72	36,222	36,222	Dec. 10	180,554,058	20,000	32,463	32,463	Nov. 20	
73	New York and Queens Electric Lt. & Pwr. Co.*k*	73	48,900	43,100	Dec. 23	168,403,952	19,200	40,650	39,583	Dec. 5	
74	Nebraska Power Company	74	34,700	.....	Dec. 18	166,110,700	18,961	34,000	.....	Dec. 19	
75	Penn. Central Light and Power Company	75	40,100	39,950	Dec. 30	165,364,793	18,761	36,100	35,700	Dec. 20	
76	Scranton Electric Company	76	.....	39,800	Dec. 23	164,162,797	18,700	.....	.....	.....	
77	Kansas Gas and Electric Company	77	35,200	.....	Dec.	163,783,700	18,697	33,000	.....	Dec. 3	
78	Hartford Electric Light Company	78	54,700	52,000	Nov. 19	163,178,438	18,600	60,200	58,500	Oct 23-Nov 22	
79	Houston Lighting and Power Company	79	33,100	.....	Nov. 25	161,307,120	18,528	27,400	.....	Dec. 3	
80	Columbus Electric and Power Company	80	38,910	.....	Dec. 5	156,732,805	34,010*l*	36,310	36,310	Oct. 16	
81	Central Maine Power Company	81	.....	33,300*b*	.....	154,117,396	17,550	32,200	.....	Dec. 3	
82	Seattle Municipal Light and Power Co	82	50,800	49,500	Dec. 9	152,125,000	17,250	35,600	34,500	Dec. 7	
83	Northern Indiana Gas and Electric Co	83	28,800*p*	.....	Dec. 23*q*	149,220,978	17,000	.....	.....	.....	
84	Empire District Electric Company	84	41,200	.....	Dec. 17	148,402,996	17,143	58,826	.....	May	
85	Virginian Power Company	85	50,500	47,000	Mar. 10	148,012,957	17,800	47,645	.....	Dec.	
86	City of Tacoma Light Department	86	33,400	32,000	Dec. 19	147,218,203	16,757	29,600	29,600	Dec. 7	
87	Yadkin River Power Company	87	48,600	.....	Dec. 30	144,412,100	16,485	48,600	.....	Dec.	
88	Utica Gas and Electric Company	88	40,428	36,000	Oct. 14	144,275,257	16,400	36,550	35,000	Dec.	
89	Potomac Edison Company	89	.....	30,115	Dec. 11	141,946,221	16,100	25,450	.....	Sept. 25	
90	Western States Gas and Electric Company	90	.....	28,500	.....	140,899,810	16,000	24,336	.....	June	
91	Pacific Power and Light Company	91	.....	.....	.....	137,304,890	15,680	25,000	.....	Sept.	
92	United Light and Power Company	92	37,110	31,860	Dec.	136,285,527	15,498	34,785	.....	Dec. 24	
93	Indiana and Michigan Electric Co	93	33,300*b*	36,600	Dec. 11*b*	133,329,990	15,200	37,970	41,500	May 8	
94	Consolidated Power and Light Co	94	29,500	27,700	.....	131,059,700	12,966	.....	.....	.....	
95	Oklahoma Gas and Electric Company (System)	95	36,456	32,000	Nov. 15	129,946,323	18,100	30,850	.....	Dec.	
96	Municipal Electric Light System of Cleveland	96	28,700	27,000	Jan. 3	128,648,350	16,000	29,100	29,100	June 28	
97	Dallas Power and Light Company	97	31,700	.....	Dec. 22	127,924,350	14,603	16,300	.....	Dec. 3	
98	Syracuse Lighting Company	98	.....	38,900*e*	Dec. 17	127,796,839	14,540	38,071	37,200	Nov.	
99	Blackstone Valley Gas and Electric Co	99	41,440*b*	45,000	Dec. 18	124,813,962	14,209*b*	40,060	43,500	Dec. 10	
100	New Bedford Gas and Edison Light Co	100	48,800	46,000	Dec. 22	121,512,151	14,095	47,782	45,500	Jan. 3	
101	York Haven Water and Power Company	101	15,700	15,700	July 23	121,334,269	13,800	.....	.....	.....	
102	Wisconsin Public Service Corpn	102	35,000	30,000	Dec.	113,239,516	12,900	.....	.....	.....	
103	Memphis Power and Light Company	103	31,700	30,800	Dec. 22	112,743,000	14,000	.....	.....	.....	
104	Cohoes Power and Light Company	104	34,000	25,000	Nov. 24	110,696,496	12,200	27,000	.....	Jan. 3	
105	Edison Electric Company, Lancaster, Pa	105	26,400*c*	.....	Dec. 10	107,440,900	12,250	24,600	24,600	Nov. 27	
106	Carolina Power and Light Company	106	25,000	.....	Dec.	100,538,848	11,479	.....	.....	.....	
	Canada										
107	Hydro-Electric Power Comm. of Ontario*m*	1	576,403	567,853	Dec. 22	3,026,615,156	344,560	520,084	.....	Nov. 27	
108	Shawinigan Water and Power Company	2	347,448	347,448	Nov. 7	2,066,066,762	235,000	272,500	272,500	Nov. 7	
109	Montreal Light, Heat and Power Consol	3	221,060	220,000	Dec. 24	1,210,105,965	150,000	197,565	197,565	Nov. 8	
110	British Columbia Electric Ry. Company*n*	4	75,200	70,900	Dec. 9	300,456,350	34,298	32,700	33,700	Dec. 29	
111	Winnipeg Munic. Hydro-Electric System	5	46,065	46,065	Oct. 28	200,520,080	22,700	39,835	39,600	Nov. 20	
	Electric Railways										
112	Interborough Rapid Transit Company	1	.....	272,760	Jan. 26	1,019,620,637	116,073	254,850	261,950	Mar. 29	
113	Chicago Surface Lines	2	.....	185,866*b*	Dec. 23	604,581,618	68,828	170,485	.....	Dec. 13	
114	Williamsburgh Power Plant Corpn	3	132,200*b*	138,000	Dec. 26	478,911,990	54,521	126,200	131,000	Jan. 17	
115	Philadelphia Rapid Transit Company	4	.....	120,885	Jan. 21	371,519,687	42,295	115,154	115,154	Jan. 17	
116	Boston Elevated Railway	5	94,869	90,557	Jan. 21	261,091,060	29,723	82,965	86,000	Dec. 19	
117	Pennsylvania Railroad Co. (Long Island Plant)	6	96,300	75,400*b*	Dec. 26	244,345,733	29,000	70,600	70,600	Feb. 15	
118	Pacific Electric Railway Company	7	50,000	44,000*b*	Apr. 3	185,000,000	21,000	43,000	43,000	Dec. 21	
119	New York Central Railroad Company	8	62,500	.....	Dec. 24	173,938,625	19,850	47,120	.....	Jan. 25	
120	Twin City Rapid Transit Company	9	.....	.....	.....	143,000,000	16,280	51,218	59,000	Feb. 13	
121	Kansas City Railways Company	10	43,000	40,820	Dec. 18	129,383,860	14,730	42,600	.....	Feb. 14	
122	Chicago, Milwaukee and St. Paul Ry. Co	11	.....	.....	.....	116,974,186*o*	.....	.....	.....	.....	

a—Include New York Edison Company, United Electric Light and Power Company, New York and Queens Light and Power Company, and the Westchester Lighting Company.
b—1 hour.
c—5 minutes.
d—Includes Union Electric Light and Power Company (Missouri), Union Electric Light and Power Company of Illinois, East St. Louis and Suburban Company.
e—15 minutes.
f—Includes Milwaukee Ele Light Company, Wisconsin Company, Wisconsin Electric Wells Power Company, an Service Company.

1923			1922			1921			1920			1919		
Date of Peak	Output for Year Kw.-hr.	Average Load During 1923 Kw.	Peak Load Kw.	Date of Peak Load	Output for Year Kw.-hr.	Peak Load Kw.	Date of Peak Load	Output for Year Kw.-hr.	Peak Load Kw.	Date of Peak Load	Output for Year Kw.-hr.	Peak Load Kw.	Date of Peak Load	Output for Year Kw.-hr.
Jan. 19	340,864,488	38,911	64,200	Nov. 20	276,936,464	45,300	Nov. 9	202,670,200	48,900	Nov. 3	255,537,150			
May 22	251,144,646	28,950												
Sept. 27	289,903,699	34,450	59,490	Dec. 6	253,305,000	50,531	Dec. 23	204,752,604	35,500	Dec. 23	175,939,618			
Jan.	182,281,000	20,808												
Sept.	203,997,334	23,287	43,589	Dec.	163,902,506	31,885	Apr.	132,788,852						
Nov. 21	373,505,000	42,638	85,000	Dec. 4	297,400,000	72,000	Nov. 23	243,087,000	54,000	Jan. 5&Nov. 6	213,232,000	57,000	Dec. 23	155,678,1
Dec. 27	269,870,850	30,807	70,000	Dec. 20	251,984,618	65,000	Dec. 14	238,028,571	62,000	Nov. 30	225,994,701	55,000	Dec. 17	204,008,1
Dec. 5	273,643,372	31,238	58,000	Dec. 14	215,785,945	46,700	Dec. 13	179,121,428	52,400	Mar.	207,830,610	48,220	Dec.	199,771,1
Dec. 18	262,940,313	30,000	54,250	Dec. 18	230,293,745	47,000	Dec. 14	208,323,000	46,150	Dec. 22	208,517,000	42,800	Dec. 18	125,840,1
Dec. 6	248,156,900	28,330	53,040	Nov. 23	193,503,573	48,734	Dec. 16	185,480,692	49,400	Oct. 29	193,601,590	42,500	Dec. 2	172,892,1
Dec. 10	259,720,216	29,100	43,000	Dec.	232,684,874	42,000	Oct. 12	187,249,647	44,400	May	247,109,963			
Dec. 17	225,453,000	25,736	66,560	Dec. 13	183,536,613	33,620	Sept. 22	156,851,213	33,620	Oct. 14	159,939,831			
Oct. 19	261,577,017	29,860	32,449	Nov. 3	246,175,203	35,018	Aug. 14	258,249,673	35,408	Nov. 12	257,752,195	35,794	Apr. 23	264,272,1
Dec. 18	240,662,700	27,472	38,500	Dec. 21	178,790,374	29,500	Oct. 15	163,286,500						
Dec. 10	196,615,340	22,444	46,500	Dec. 8	159,836,687	37,500	Nov. 28	134,588,457	31,500	May25&Sept28	129,618,270			
Dec. 18	127,357,201	14,563												
	244,600,000	27,900	42,600	Dec. 4	205,447,368	35,600	Dec. 19	154,500,000	35,300	Oct.	148,700,000			
June 13	217,138,000	24,800	56,400	May 16	201,796,000	57,900	May 17	170,826,000	55,500	May 27	212,126,530			
Dec. 5	196,432,892	22,400	45,706	Dec. 14	158,371,247	28,255	Nov. 28	101,129,915	33,392	Oct. 12	145,111,822			
June 11	219,653,900	25,011	36,200	July 14	186,671,850	45,700	June6&Aug. 8	199,452,965	32,600	July 23	175,104,808	29,200		165,782,1
Dec.	211,765,420	24,174	46,500	Dec. 13	188,000,000									
Nov. 23	251,641,760	26,443	52,100	Dec. 14	187,785,967	38,440	Dec. 12	160,423,240			153,626,000			
Aug.	222,590,000	25,410	38,323	July 24	212,237,000	35,635	Sept. 1	190,215,255	34,235	July	184,843,000			
Dec.	145,302,874	16,587	28,800	Dec.	102,631,000									
Sept. 5	174,670,219	19,941	30,800	Oct.	128,345,120	26,300	Dec.	114,587,986						
Dec.	168,814,810	19,271	32,100	Nov. 20	127,315,007	27,900	Nov. 30	99,815,200	28,000	Aug. 10	133,994,030			
Dec. 5	162,443,207	18,544												
Dec.	148,000,000	16,895												
Dec. 19	152,702,800	17,411	22,700	Dec. 29	120,698,840	22,190	Dec. 12	113,913,335	20,600	Dec. 10	112,736,089			
Dec. 4	160,754,592	19,201	39,500	Dec. 13	136,850,900	32,500	Dec. 7	112,472,748						
May 8-11	169,453,319	19,350	38,326	Dec. 14	138,356,280	29,350	Nov. 9	108,829,278	27,240	Sept. 15	114,416,090			
Nov. 20	153,500,531	17,523	27,695	Dec. 20	131,293,165	20,270	Mar. 16	133,091,607	20,335	Jan. 28	143,025,818			
Dec. 5	143,749,060	16,409	35,300	Nov. 15	120,011,093									
Dec. 19	160,624,600	18,335	30,200	Dec. 6	140,272,500	28,200	Oct. 28	127,758,800	25,500	Nov. 26	114,200,500			
Dec. 20	147,423,930	16,890												
Dec. 3	160,464,200	18,300	29,600	Dec. 7	139,167,200	25,000	Dec.	130,479,900						
Oct 23-Nov 22	181,202,880	20,685	56,000	Dec. 14	134,000,000	31,700	Nov. 14	97,754,000	32,500	Jan. 9	103,000,000			
Dec. 3	129,318,120	14,762	24,200	Nov. 22										
Oct. 16	160,246,106	18,293												
Dec. 3	146,136,310	16,700	32,500	Dec. 11	128,445,449									
Dec. 7	115,431,550	13,150												
May	152,681,540	17,400										32,030	Oct.	130,114,1
Dec.	163,147,137	18,624												
Dec. 7	136,757,822	15,611	31,900	Dec. 5	112,546,832	28,400	Dec. 20	95,697,600	22,700	Nov. 10	120,598,174			
Dec.	165,846,240	18,932	37,000	Nov. 8	142,161,182									
Dec.	130,921,606	14,945												
Sept. 25	112,820,766	12,879												
June	114,597,745													
Sept.	116,676,395	13,319												
Dec. 24	146,987,476	16,800	35,505		129,236,964									
May 8	156,333,990	17,846	37,450	Dec. 4	136,825,060	28,280	Dec. 16	105,593,490	27,130	Nov. 9	103,693,910			
Dec.	108,364,544													
June 28	138,592,090	16,000	25,300	Dec. 14	116,355,460									
Dec. 3	105,400,728	12,032												
Nov.	159,670,385	18,227	33,686	Dec. 8	124,457,748									
Dec. 10	126,621,397	14,430	38,030	Dec. 20	110,225,488									
Jan. 3	133,707,946	15,280	47,500	Dec. 18	115,938,294	40,308	Dec. 2	89,857,700	33,700	June 17	107,599,392			
Jan. 3	115,661,600	13,203	28,000	Dec. 20	103,195,985									
Nov. 27	100,205,700	11,439												
Nov. 27	2,906,519,819	331,795	460,471	Dec. 13	2,392,092,267									
Nov. 7	1,667,397,876	190,342	250,000	Dec. 19	1,383,390,773	160,500	Dec. 19	863,124,240	192,200	Nov. 17	1,140,759,076	172,900	Jan. 14	1,031,111,1
Nov. 8	1,089,099,507	124,326	185,500	Nov. 27	945,200,656	165,900	Nov. 14	907,237,573	169,450	Nov. 17	900,328,757	164,415	Dec. 16	852,680,1
Dec. 29	129,548,600	14,789				27,200	Mar.	122,684,800						
Nov. 20	164,609,860	18,800	38,048	Dec. 11	144,509,000	34,264	Nov. 23	125,124,855						
Mar. 29	960,340,481	109,625	246,770	Jan. 24	886,223,920	242,760	Dec. 30	846,487,668	242,020	Jan. 31	816,603,610	239,940	Dec. 19	810,158,1
Dec. 13	576,457,379	60,205			735,246,576			712,683,840						
Jan. 17	449,827,260	51,314	118,800	Jan. 24	413,992,125	116,000	Dec. 22	383,009,325	111,147	Jan. 15	389,784,451	111,000	Dec. 16	406,130,1
Jan. 17	383,313,078	43,757	110,446	Dec. 19	346,506,580	105,303	Dec. 22	333,222,786	102,210	Jan. 14	349,027,334	101,120	Dec. 18	349,542,1
Dec. 19	257,983,320	29,382	78,755	Dec. 13	240,547,615	25,905	Jan. 18	223,061,330	72,295	Jan. 14	246,212,170	71,760	Mar. 23	240,429,1
Feb. 15	244,113,039	26,551	72,000	Dec. 30	214,906,725	64,000	Dec. 30	201,922,210	55,200	Jan. 5	199,737,907	53,900	Dec. 19	181,017,1
Dec. 21	198,211,000	22,627												
Jan. 25	163,895,940	18,709	48,470	Jan. 3	157,450,819	50,750	Dec. 23	149,275,239	46,440	Dec. 27	157,132,366	44,100	Dec. 29	140,435,1
Feb. 13	146,605,919	16,736	47,005	Dec. 14	145,675,337	44,599	Feb. 8	145,517,164	42,700	Dec. 21	139,711,248	42,612	Nov. 28	133,676,1
Feb. 14	128,302,450	14,647	40,200	Dec. 12	123,830,190	43,500	Jan. 13	129,804,772	51,740	Jan. 8	189,172,898	49,430	Oct. 27	211,707,1
	122,643,791													

...Milwaukee Electric Railway and ..., Wisconsin Gas and Electric ...onsin Electric Power Company, ...Company, and Badger Public ...y.

g—Includes 11,000 kw. joint operation to Commonwealth Edison Company.

h—Includes 50,961,607 kw.-hr. joint generation with Commonwealth Edison Company.

i—Includes 5,802 kw. joint operation with Commonwealth Edison Company.

j—Includes also Nevada-California Power Company, and Desert Water Oil and Irrigating Company.

k—Also included under "Edison-United Companies-New York."

l—Average load of monthly average day peaks.

m—Includes Ontario Power Company.

n—Includes also Vancouver Power Company and Western Power Company.

26	380,630,188	43,451	81,100	Dec. 14	304,997,551	61,500	Dec. 21	243,370,354	60,700	Dec. 2	277,100,000	39,500	Dec. 23	144	53,094
4	358,353,618	40,800	80,000	Nov. 15	317,068,699	72,000	Nov. 3 & 28	282,084,977	76,000	Apr. 9	293,721,290	71,700	Dec. 18	262	34,541
20	365,997,750	41,780	71,800	Dec. 28	324,116,190	64,800	Dec. 20	298,514,571	62,600	Dec. 6	292,318,971	56,300	Dec. 22	271	00,300
19	340,864,488	38,911	64,200	Nov. 20	276,936,464	45,300	Nov. 9	202,670,200	48,900	Nov. 3	255,537,150	.....	.....	.....		
22	251,144,646	28,950	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
27	289,903,699	34,450	59,490	Dec. 6	253,305,000	50,531	Dec. 23	204,752,604	35,500	Dec. 23	175,939,618	.....	.....	.....		
	182,281,000	20,808	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
	203,997,334	23,287	43,589	Dec.	163,902,506	31,885	Apr.	132,788,852	.....	.....	.....	.....	.....	.....		
21	373,505,000	42,638	85,000	Dec. 4	297,400,000	72,000	Nov. 23	243,087,000	54,000	Jan. 5&Nov. 6	213,232,000	57,000	Dec. 23	155	678,890
27	269,870,850	30,807	70,000	Dec. 20	251,984,618	65,000	Dec. 14	238,028,571	62,000	Nov. 30	225,994,701	55,000	Dec. 17	204	008,647
5	273,643,372	31,238	58,000	Dec. 14	215,785,945	46,700	Dec. 13	179,121,428	52,400	Mar.	207,830,610	48,220	Dec.	199	771,799
18	262,940,313	30,000	54,250	Dec. 18	230,293,745	47,000	Dec. 14	208,323,000	46,150	Dec. 22	208,517,000	42,800	Dec. 18	125	840,000
6	248,156,900	28,330	53,040	Nov. 23	193,503,573	48,734	Dec. 16	185,480,692	49,400	Oct. 29	193,601,590	42,500	Dec. 2	172	892,249
10	259,720,216	29,100	43,000	Dec.	232,684,874	42,000	Oct. 12	187,249,647	44,400	May	247,109,963	.....	.....	.....		
17	225,453,000	25,736	66,560	Dec. 13	183,536,613	33,620	Sept. 22	156,851,213	33,620	Oct. 14	159,939,831	.....	.....	.....		
19	261,577,017	29,860	32,449	Nov. 3	246,175,203	35,018	Aug. 14	258,249,673	35,408	Nov. 12	257,752,195	35,794	Apr. 23	264	272,468
18	240,662,700	27,472	38,500	Dec. 21	178,790,374	29,500	Oct. 15	163,286,500	.....	.....	.....	.....	.....	.....		
10	196,615,340	22,444	46,500	Dec. 8	159,836,687	37,500	Nov. 28	134,588,457	31,500	May25&Sept28	129,618,270	.....	.....	.....		
18	127,357,201	14,563	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
	244,600,000	27,900	42,600	Dec. 4	205,447,368	35,600	Dec. 19	154,500,000	35,300	Oct.	148,700,000	.....	.....	.....		
13	217,138,000	24,800	56,400	May 16	201,796,000	57,900	May 17	170,826,000	55,500	May 27	212,126,530	.....	.....	.....		
5	196,432,892	22,400	45,706	Dec. 14	158,371,247	28,255	Nov. 28	101,129,915	33,392	Oct. 12	145,111,822	.....	.....	.....		
11	219,653,900	25,011	36,200	July 14	186,671,850	45,700	June6&Aug. 8	199,452,965	32,600	July 23	175,104,808	29,200	.....		165,782,785	
	211,765,420	24,174	46,500	Dec. 13	188,000,000	.....	.....	.....	.....	.....	.....	.....	.....	.....		
23	231,641,760	26,443	52,100	Dec. 14	187,785,967	38,440	Dec. 12	160,423,240	.....	.....	153,626,000	.....	.....	.....		
	222,590,000	25,410	38,323	July 24	212,237,000	35,635	Sept. 1	190,215,255	34,235	July	184,843,000	.....	.....	.....		
	145,302,874	16,587	28,800	Dec.	102,631,000	.....	.....	.....	.....	.....	.....	.....	.....	.....		
5	174,670,219	19,941	30,800	Oct.	128,345,120	26,300	Dec.	114,587,986	.....	.....	.....	.....	.....	.....		
	168,814,810	19,271	32,100	Nov. 20	127,315,007	27,900	Nov. 30	99,815,200	28,000	Aug. 10	133,994,030	.....	.....	.....		
5	162,443,207	18,544	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
	148,000,000	16,895	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
19	152,702,800	17,411	22,700	Dec. 29	120,698,840	22,190	Dec. 12	113,913,335	20,600	Dec. 10	112,736,089	.....	.....	.....		
4	160,754,592	19,201	39,500	Dec. 13	136,850,900	32,500	Dec. 7	112,472,748	.....	.....	.....	.....	.....	.....		
8-11	169,453,319	19,350	38,326	Dec. 14	138,356,280	29,350	Nov. 9	108,829,278	27,240	Sept. 15	114,416,090	.....	.....	.....		
20	153,500,531	17,523	27,695	Dec. 20	131,293,165	20,270	Mar. 16	133,091,607	20,335	Jan. 28	143,025,818	.....	.....	.....		
5	143,749,060	16,409	35,300	Nov. 15	120,011,093	.....	.....	.....	.....	.....	.....	.....	.....	.....		
19	160,624,600	18,335	30,200	Dec. 6	140,272,500	28,200	Oct. 28	127,758,800	25,500	Nov. 26	114,200,500	.....	.....	.....		
20	147,423,930	16,890	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
3	160,464,200	18,300	29,600	Dec. 7	139,167,200	25,000	Dec.	130,479,900	.....	.....	.....	.....	.....	.....		
-Nov22	181,202,880	20,685	56,000	Dec. 14	134,000,000	31,700	Nov. 14	97,754,000	32,500	Jan. 9	103,000,000	.....	.....	.....		
3	129,318,120	14,762	24,200	Nov. 22	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
16	160,246,106	18,293	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
3	146,136,310	16,700	32,500	Dec. 11	128,445,449	.....	.....	.....	.....	.....	.....	.....	.....	.....		
7	115,431,550	13,150	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
y	152,681,540	17,400	.....	.....	.....	.....	.....	.....	.....	.....	.....	32,030	Oct.		130,114,100	
	163,147,137	18,624	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
7	136,757,822	15,611	31,900	Dec. 5	112,546,832	28,400	Dec. 20	95,697,600	22,700	Nov. 10	120,598,174	.....	.....	.....		
	165,846,240	18,932	37,000	Nov. 8	142,161,182	.....	.....	.....	.....	.....	.....	.....	.....	.....		
	130,921,606	14,945	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
25	112,820,766	12,879	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
	114,597,745	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
	116,676,395	13,319	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
24	146,987,476	16,800	35,505	.....	129,236,964	.....	.....	.....	.....	.....	.....	.....	.....	.....		
8	156,333,990	17,846	37,450	Dec. 4	136,825,060	28,280	Dec. 16	105,593,490	27,130	Nov. 9	103,693,910	.....	.....	.....		
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
	108,364,544	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
28	138,592,090	16,000	25,300	Dec. 14	116,355,460	.....	.....	.....	.....	.....	.....	.....	.....	.....		
3	105,400,728	12,032	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
	159,670,385	18,227	33,686	Dec. 8	124,457,748	.....	.....	.....	.....	.....	.....	.....	.....	.....		
10	126,621,397	14,430	38,030	Dec. 20	110,225,488	.....	.....	.....	.....	.....	.....	.....	.....	.....		
3	133,707,946	15,280	47,500	Dec. 18	115,938,294	40,300	Dec. 2	89,857,700	33,700	June 17	107,599,392	.....	.....	.....		
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
3	115,661,600	13,203	28,000	Dec. 20	103,195,985	.....	.....	.....	.....	.....	.....	.....	.....	.....		
27	100,205,700	11,439	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
27	2,906,519,819	331,795	460,471	Dec. 13	2,392,092,267	.....	.....	.....	.....	.....	.....	.....	.....	.....		
7	1,667,397,876	190,342	250,000	Dec. 19	1,383,390,773	160,500	Dec. 19	863,124,240	192,200	Nov. 17	1,140,759,076	172,900	Jan. 14	1,031,111,695		
8	1,089,099,507	124,326	185,500	Nov. 27	945,200,656	165,900	Nov. 18	907,237,573	169,450	Nov. 17	900,328,757	164,415	Dec. 16	852,680,550		
29	129,548,600	14,789	.....	.....	.....	27,200	Mar.	122,684,800	.....	.....	.....	.....	.....	.....		
20	164,609,860	18,800	38,048	Dec. 11	144,509,000	34,264	Nov. 23	125,124,855	.....	.....	.....	.....	.....	.....		
29	960,340,481	109,625	246,770	Jan. 24	886,223,920	242,760	Dec. 30	846,487,668	242,020	Jan. 31	816,603,610	239,940	Dec. 19	810,158,475		
13	576,457,379	60,205	.....	.....	735,246,576	.....	.....	712,683,840	.....	.....	.....	.....	.....	.....		
17	449,827,260	51,314	118,800	Jan. 24	413,992,125	116,000	Dec. 22	383,009,325	111,147	Jan. 15	389,784,451	111,000	Dec. 16	406,130,443		
17	383,313,078	43,757	110,446	Dec. 19	346,506,580	105,303	Dec. 22	333,222,786	102,210	Jan. 14	349,027,334	101,120	Dec. 18	349,542,666		
19	257,983,320	29,382	78,755	Dec. 13	240,547,615	25,905	Jan. 18	223,061,330	72,295	Jan. 14	246,212,170	71,760	Mar. 23	240,429,915		
15	244,113,039	26,551	72,000	Dec. 30	214,906,725	64,000	Dec. 30	201,922,210	55,200	Jan. 5	199,737,907	53,900	Dec. 19	181,017,940		
21	198,211,000	22,627	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		
25	163,895,940	18,709	48,470	Jan. 3	157,450,819	50,750	Dec. 22	149,275,239	46,440	Dec. 27	157,132,366	44,100	Dec. 29	140,435,406		
13	146,605,919	16,736	47,005	Dec. 14	145,675,337	44,599	Feb. 8	145,517,164	42,700	Dec. 21	139,711,248	42,612	Nov. 28	133,676,028		
14	128,302,450	14,647	40,200	Dec. 12	123,830,190	43,500	Jan. 13	129,804,772	51,740	Jan. 8	189,172,898	49,430	Oct. 27	211,707,571		
.....	122,643,791	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....		

1923			1922			1921			1920			1919		
te of eak	Output for Year Kw.-hr.	Average Load During 1923 Kw.	Peak Load Kw.	Date of Peak Load	Output for Year Kw.-hr.	Peak Load Kw.	Date of Peak Load	Output for Year Kw.-hr.	Peak Load Kw.	Date of Peak Load	Output for Year Kw.-hr.	Peak Load Kw.	Date of Peak Load	Output for Year Kw.-hr.

aukee Electric Railway and Wisconsin Gas and Electric in Electric Power Company, pany, and Badger Public

g—Includes 11,000 kw. joint operation to Commonwealth Edison Company.

h—Includes 50,961,607 kw.-hr. joint generation with Commonwealth Edison Company.

i—Includes 5,802 kw. joint operation with Commonwealth Edison Company.

j—Includes also Nevada-California Power Company, and Desert Water Oil and Irrigating Company.

k—Also included under "Edison-United Companies-New York."

l—Average load of monthly average day peaks.

m—Includes Ontario Power Company.

n—Includes also Vancouver Power Company and Western Power Company.

Output for Year Kw.-hr.	1918 Peak Load Kw.	1918 Date of Peak Load	1918 Output for Year Kw.-hr.	1917 Peak Load Kw.	1917 Date of Peak Load	1917 Output for Year Kw.-hr.	1916 Peak Load Kw.	1916 Date of Peak Load	1916 Output for Year Kw.-hr.	1915 Peak Load Kw.	1915 Date of Peak Load	1915 Output for Year Kw.-hr.	Line Number
144 53,094	50,250	Nov.8-Jan.23	174,567,275	42,000	Dec. 7 & 14	158,570,164	41,575	Dec. 12 & 22	151,128,510	38,400	Dec. 15 & 29	128,640,000	38
262 34,541	68,000	Nov. 8	238,489,012	78,200	Apr. 24	258,607,882	72,600	Mar. 17	211,872,638	77,100	Dec. 17	179,976,596	39
271 00,300	56,900	Dec. 23	258,424,940	50,620	Dec. 31	218,086,315	47,335	Nov. 29	194,146,555	47,150	Dec. 30	186,372,553	40
													41
													42
													43
													44
													45
155,678,890	45,000	June 20	150,028,780	33,500	Dec. 19	113,238,441							46
204,008,647	48,000	Dec. 20	173,180,014	44,800		140,762,646	38,600	Dec. 18	122,158,818	36,200	Nov. 30	111,082,725	47
199,771,799	40,305	Dec.	161,103,970	37,627	Dec.	162,061,232	36,428	Dec. 22	134,842,360	33,370	Dec. 31	100,168,375	48
125,840,000	35,700	Dec. 18	164,810,750	37,000	Dec. 18	153,128,026	33,900	Dec. 18	132,275,000				49
172,892,249	52,300	Nov. 22	196,171,300	42,154	Dec. 13	162,490,264	40,250	Dec. 16	146,069,428	37,000	Dec. 15	123,401,451	50
													51
													52
264,272,468	33,519	Dec. 24	233,381,654	32,990	Dec. 3	221,538,757							53
													54
													55
													56
													57
													58
165,782,785	28,200	Aug 6	161,347,690	25,900	Aug. 9	148,267,885	22,400	Apr. 28	131,084,265	20,300	July 21	114,187,385	59
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130,114,100	25,400	Sept. 5	114,446,685	123,000	Apr. 1	105,487,860	26,900	Mar. 26	119,280,363				83
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1,031,111,695	136,800	Sept. 24	1,058,136,117	119,000	Dec. 21	633,573,610	108,000	Dec. 14	478,540,000				107
852,680,550	166,730	Dec. 6	976,462,529	152,665	Nov. 12	946,832,817							108
													109
													110
													111
810,158,475	204,000	Dec. 30	731,058,965	184,000	Dec. 11	689,665,975							112
													113
406,130,443	109,892	Feb. 21	385,346,075	115,792	Feb. 2	396,068,887							114
349,542,666	94,730	Dec. 27	339,232,739	103,220	Jan. 11	348,372,056							115
240,429,915	67,965	Mar. 23	228,131,265	79,535	Feb. 12	262,920,065							116
181,017,940	48,600	Jan. 3	165,377,180	45,000	Dec. 10	161,673,710							117
													118
140,435,406	38,360	Jan. 22	127,412,457	42,480	Dec. 10	147,809,842							119
133,676,028	44,966	Feb. 19	131,351,288	51,956	Mar. 31	152,469,348							120
211,707,571	57,280	Jan. 11	209,378,747	61,350	Feb. 2	236,675,814							121
													122

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ny.
Company

o—Estimated.
p—Northern Division, 5,400 must be added for Southern Division.
q—Northern Division Dec. 18 for Southern Division.
r—8-hour.
s—Generated peak estimated over 30 minutes, system peak including purchased power totaled 54,900 kw.

Table II—Detailed Data on Ge
Having an Ou

Line Number	Section and System	Generator Rating		Generated and Purchas 1924	
		Total Fuel Burning Plants Jan. 1, 1925 Kva	Total Hydro Plants Jan. 1, 1925 Kva	Total Output Kw.Hr.	G
	New England				
1	Edison Electric Illuminating Company of Boston	208,417	o	564,459,887	5
2	New England Power Company System	17,900	105,300	562,802,440	3
3	Narragansett Electric Lighting Company	127,400	o	289,626,000	2
4	Turners Falls Power and Light Company	37,000	67,500	238,574,255	2
5	Connecticut Light and Power Company	102,575	30,600	227,558,428	1
6	Hartford Electric Light Company	76,000	1,500	163,178,438	1
7	Central Maine Power Company	16,875	49,842	154,117,396	1
8	Blackstone Valley Gas and Electric Company	36,650	1,750	124,813,962	
9	New Bedford Gas and Edison Light Company	92,000	o	121,814,400	1
	Middle Atlantic States				
10	Niagara Falls Power Company	o	600,090	2,858,482,674	2,8
11	Edison United Companies, New York	841,000	o	2,056,432,473	2,0
12	Philadelphia Electric Company	527,402	o	1,313,297,283	1,3
13	Public Service Electric and Gas Company	414,800	o	1,198,240,840	1,1
14	Duquesne Light Company	347,000	o	1,093,939,801	1,0
15	West Penn System	333,410a	210a	995,609,902	9
16	Buffalo General Electric Company	105,555b	o	759,852,160	1
17	Niagara, Lockport and Ontario Power Company	35,200	32,000	721,454,633	
18	Brooklyn Edison Company	429,719	o	684,632,824	6
19	Pennsylvania Power and Light Company	152,950	450	630,923,200	5
20	Pennsylvania Water and Power	o	119,750	487,859,000	4
21	Adirondack Power and Light Corporation	75,000	151,400	412,143,909	2
22	Penn Public Service System	121,640	24,000	298,707,292	2
23	Rochester Gas and Electric Corporation	63,975a	39,585a	267,223,754	2
24	Metropolitan Edison Company	71,000a	500a	194,606,000	1
25	New York and Queens Electric Light and Power Company	5,000	o	168,403,952	
26	Penn Central Light and Power Company	43,500	4,000	165,364,793	1
27	Scranton Electric Company	43,150	o	164,162,797	1
28	Utica Gas and Electric Company	20,000	30,500	144,275,257	1
29	Syracuse Lighting Company	o	o	127,796,839	
30	York Haven Water and Power Company	o	15,000	121,334,269	
31	Cohoes Power and Light Corporation	o	48,500	110,696,496	1
32	Edison Electric Company (Lancaster, Pa.)	o	o	107,440,900	
	South Atlantic States				
33	Southern Power Company	132,250	375,650	1,054,909,770	1,0
34	Consolidated Electric Light and Power Company	199,000	600	648,307,210	3
35	Georgia Railway and Power Company	21,500	151,300	395,219,890	3
36	Potomac Electric Power Company	120,022	o	286,695,035	2
37	Virginia Railway and Power Company	111,500	19,402	276,663,178	2
38	Appalachian Power Company	58,750	30,000	244,300,000	2
39	Columbus Electric and Power Company	9,000	23,200	156,732,805	1
40	Virginia Power Company	88,722	o	148,012,957	1
41	Yadkin River Power Company	1,500a	24,000a	144,412,100	
42	Potomac Edison Company	53,440	5,700	141,946,221	1
43	Consolidated Power and Light Company	32,000	o	131,059,700	1
44	Carolina Power and Light Company	38,285	7,455	100,538,848	
	East North Central States				
45	Commonwealth Edison Company	769,000a	o	2,787,090,000	2,7
46	Detroit Edison Company	453,000a	5,850a	1,460,631,400	1,4
47	Cleveland Electric Illuminating Company	360,000	o	865,079,266	8
48	Consumers Power Company	136,906	102,937	602,152,714	5
49	Milwaukee Group (North American Company)	226,425	15,725f	595,329,699	5
50	Union Gas and Electric Company	112,000	o	480,219,880	4
51	Public Service Company of Northern Illinois	147,615ag	4,100a	514,065,402h	4
52	Ohio Public Service Company	170,125	760	417,544,531	3
53	Pennsylvania—Ohio Power and Light Company	93,800	1,250	341,939,101f	3
54	Toledo Edison Company	143,540	11,950	279,848,936	2
55	Northern Ohio Traction and Light Company	67,000a	2,175a	267,074,055	1
56	Michigan Northern Power Company	o	45,600k	258,750,604	2
57	Dayton Power and Light Company	125,280	o	249,330,663	2
58	Columbus Railway, Power and Light Company	84,000	o	218,909,460	2
59	Central Illinois Public Service Company	81,415	o	202,871,998	1
60	American Public Utilities Company	97,980	480	193,205,739	1
61	Indianapolis Light and Heat Company	84,500	o	181,810,339	1
62	Northern Indiana Gas and Electric Company	42,600	o	149,220,978	1
63	United Light and Power Company	86,300	5,800	136,285,527	
64	Indiana and Michigan Electric Company	24,000a	21,700a	133,329,990	1
65	Cleveland Municipal Electric Light System	42,000	o	128,648,350	1
66	Wisconsin Public Service Corporation	16,250a	30,900	113,239,516	
	West North Central States				
67	St. Louis and East St. Louis Group (North American Company)	241,850	72,000n	801,776,855	4
68	Northern States Power Company	272,704o	121,378o	691,099,810	6
69	Mississippi River Power Company	o	139,000	677,358,697p	6
70	Minnesota Power and Light Company	14,450a	82,665a	340,181,750	3
71	Kansas City Power and Light Company	136,682	o	315,582,737	3
72	North West Utilities Company	33,995a	48,982a	298,281,324	3
73	Nebraska Power Company	53,000a	o	166,110,700	1
74	Kansas Gas and Electric Company	44,190a	550a	163,783,700	1
75	Empire District Electric Company	59,635	4,750	148,402,996	
	East South Central States				
76	Alabama Power Company	176,408r	159,025	823,247,290	4
77	Tennessee Electric Power Company	115,087	120,505	477,593,985	2
78	Birmingham Electric Company	11,700a	o	193,987,141	
79	Louisville Gas and Electric Company	.....	.....	183,091,200	
80	Memphis Power and Light Company	60,620	.....	112,743,000	
	West South Central States				
		36,073a		262,187,000s	

on Generator Rating, Output, and Distribution of En
an Output Over 100,000,000 Kw.-Hr. During 1923 an

rated and Purchased Output 1924			Distribution of Energy in Kilowatt Hours 1924						Generated an	
otal tput .Hr.	Generated Kw-Hr.	Purchased Kw-Hr.	Light	Power	Light and Power	Electric Railways	Other Public Utilities	Intra-Company Business and Line Losses, etc.	Total Output KW-Hr.	
459,887	549,118,300	15,341,587	.....	.....	364,870,347	8,351,440	61,617,963	129,620,137	526,465,178	5
802,440	351,886,528	210,915,912	o	224,681,020	224,681,020	43,552,004	222,169,109	72,409,307	575,067,581	2
626,000	278,187,000	11,439,000	43,017,000	107,685,000	150,702,000	398,000	89,594,000	40,590,000	373,504,000	3
574,255	211,547,000	27,027,255	o	79,768,568	79,768,568	28,296,258	103,318,452	27,190,977	217,138,000	1
558,428	198,541,780	29,016,648	29,235,644	112,140,699	141,376,343	18,835,628	24,559,431	8,992,824	196,432,892	1
178,438	157,257,770	5,920,668	37,137,108	53,655,965	90,793,073	2,909,600	56,092,357	13,383,408	181,202,880	1
117,396	145,561,076	8,556,320	23,567,720	71,737,530	95,305,250	11,591,128	2,031,703	45,189,315	147,136,310	1
313,962	67,786,860	57,027,102	14,613,540	76,379,533	90,993,073	3,178,815	9,097,122	21,544,952	124,094,235	1
314,400	123,814,400	o	12,303,695	75,370,128	87,673,823	1,099,084	16,444,160	16,295,084	133,707,946	1
482,674	2,858,482,674	o	2,029,080	1,691,069,408	1,663,098,488	8,989,266	1,012,230,878	144,164,042	2,595,847,000	2,5
432,473	2,055,459,073	973,400	.....	.....	1,179,740,790	229,810,026	307,250,289	339,631,184	1,899,679,975	1,8
297,283	1,313,297,283	o	286,417,948	444,532,097	730,950,045	355,141,367	64,855,175	162,350,696	1,148,511,101	1,1
240,840	1,128,357,890	69,882,950	287,433,603	452,214,021	739,647,624	220,586,264	615,300	237,391,652	1,084,990,294	1,0
939,801	1,073,737,420	20,202,381	239,578,014	425,416,857	664,994,871	239,798,684	37,942,900	151,203,346	1,063,046,267	1,0
609,902	994,413,228	1,196,674	97,295,486	620,732,388	718,027,874	79,405,699	42,442,843	155,733,486	945,691,000	
352,160	153,000,410	606,851,750	161,534,013	418,073,511	579,607,524	78,335,300	o	101,909,336	707,958,270	
454,633	88,890,815	632,563,818	.....	.....	162,558,134	83,827,686	380,525,787	94,543,026	707,087,842	
632,824	671,025,380	13,607,444	325,883,335c	155,386,515c	481,269,850	5,088,400	14,294,494	183,980,080	598,808,757	
923,200	540,823,800	90,099,400	72,881,892	432,927,187	505,809,079	40,470,855	12,813,330	71,829,936	602,691,800	
359,000	487,859,000	o	o	o	o	o	432,836,836	55,022,164	420,028,600	
143,909	266,466,290	145,677,619	32,748,707	122,312,454	155,061,161	99,014,422	95,354,927	62,713,399	380,630,188	
707,292	261,278,759	37,428,533	41,682,019	178,086,517	219,768,536	15,432,536	5,878,708	57,627,512	182,281,000	
223,754	230,012,020	37,211,734	108,986,282	64,577,769	173,564,051	41,797,859	6,163,269	45,698,575	248,156,900	
606,000	167,000,000	27,606,000	18,249,214	69,191,393	87,440,607	21,206,435	47,200,436	.....	168,814,810	
403,952	3,677,810	164,726,142	65,686,709	70,386,356	136,073,065	3,050,660	o	29,280,227	143,749,600	
364,793	164,185,034	1,179,759	21,012,907	95,801,311	116,814,218	1,236,118	11,773,213	35,541,244	147,423,930	
162,797	158,597,427	5,565,370	32,220,679	83,593,765	115,814,444	24,537,762	o	.....	.....	
275,257	105,822,689	38,452,568	17,864,134	47,573,869	65,438,003	2,293,815	47,054,906	29,488,533	130,921,606	
796,839	o	127,796,839	24,093,489	86,390,604	110,484,093	2,164,812	2,342,672	12,805,262	159,670,385	
334,269	94,862,800	26,471,469	160,623	49,832,718	49,993,341	o	52,328,657	19,012,271	.....	
696,496	109,625,096	1,071,400	2,661,728	38,344,794	41,006,522	o	59,633,538	10,056,436	115,661,600	
440,900	o	107,440,900	15,397,381d	46,987,874	62,385,255	18,862,075	6,372,720	19,820,850	100,205,700	
909,770	1,016,287,270	38,622,500	.....	.....	.....	.....	.....	.....	1,001,026,319	
807,210	352,598,510	295,708,700	.....	.....	498,200,599	150,106,611	o	o	678,346,746	
219,890	346,157,634	49,062,256	49,094,639	173,254,866	222,349,505	59,899,115	31,675,955	82,295,315	358,353,618	
595,035	286,688,808	6,227	90,058,157	54,221,042	144,279,199	81,606,414	2,448,335	58,361,087	269,870,850	
563,178	256,151,566	20,511,612	.....	.....	175,711,712	50,218,028	3,056,797	47,676,641	262,940,313	
300,000	243,500,000	900,000	6,811,482	194,186,516	200,997,998	12,000,000	9,404,000	21,900,000	244,600,000	
732,805	145,872,848	10,859,957	4,386,263	93,864,331	98,250,594	41,723,765e	.....	16,758,446	160,246,106	
012,957	147,984,957	28,000	o	94,908,023	94,908,023	o	36,935,479	16,169,455	163,147,137	
412,100	86,561,100	57,851,000	7,674,998	65,147,134	72,822,132	o	44,390,935	27,199,033	165,846,240	
946,221	141,134,955	811,266	15,133,711	92,158,140	107,291,851	6,308,000	4,863,372	22,937,000	112,820,766	
059,700	112,603,700	18,456,000	10,921,283	30,059,230	40,980,513	5,687,912	68,573,906	15,817,369	.....	
638,848	21,200,767	79,338,081	12,069,724	63,793,019	75,862,743	o	1,135,339	23,540,766	.....	
090,000	2,755,772,000	31,318,000	584,059,000	953,248,000	1,537,307,000	835,606,000	84,360,000	329,817,000	2,573,286,711	2
631,400	1,460,315,900	315,500	310,979,421	692,800,397	1,003,779,818	151,529,760	43,910,168	261,411,600	1,360,017,300	1
079,266	865,079,266	o	156,163,991	404,419,392	560,583,383	118,934,490	64,930,859	120,630,534	802,859,991	
152,714	568,077,164	34,075,550	123,347,162	264,534,806	387,881,968	68,701,588	3,197,804	142,371,354	574,031,472	
329,699	525,461,526	69,868,173	.....	.....	.....	.....	.....	.....	553,624,392	
219,880	426,707,880	53,512,000	81,159,242	182,869,568	264,028,810	66,646,010	60,879,180	38,270,088	438,386,386	
965,402h	480,533,975	33,975,000	81,027,543	201,923,334	282,950,877	49,768,432	39,182,442	91,202,044i	427,460,668	
644,531	361,060,923	56,483,608	36,186,004	275,701,792	311,887,796	o	62,806,399	42,850,336	415,424,787	
939,101j	321,832,125	20,106,976	49,649,388m	204,045,895	253,695,283	35,149,775	3,185,637	33,860,213	340,864,488	
348,936	278,272,208	1,576,728	57,944,510	107,277,117	165,221,627	44,172,968	26,043,493	44,410,848	273,643,372	
074,055	183,174,750	83,899,305	43,717,352	117,033,037	160,750,389	51,592,991	15,495,265	11,459,421	259,720,216	
750,604	258,750,604	o	3,284	256,259,344	256,262,628	694,400	1,442,712	350,864	261,577,017	
330,663	248,818,863	511,800	37,107,824	81,589,742	118,697,566	42,778,723	58,656,410	29,197,964	196,615,340	
909,460	218,909,460	o	.....	.....	170,294,860	35,700,950	7,064,700	5,848,950	231,641,760	
471,998	139,773,262	63,098,726	35,441,780	97,812,512	133,254,292	o	13,355,798	56,102,769	174,685,799	
205,739	183,258,978	9,946,761	46,876,884l	68,126,066	115,002,950	4,766,022	25,425,632	47,011,145	148,000,000	
310,339	181,810,339	o	20,796,244	104,043,495	124,839,739	o	14,370,931	42,599,669	169,453,319	
220,978	113,630,385	35,590,593	26,554,930	85,051,688	111,606,618	11,121,250	6,897,581	19,495,529	.....	
285,527	98,174,915	38,110,612	33,003,619	51,328,496	84,332,115	24,866,789	6,766,912	20,319,711	146,987,474	
329,990	132,992,990	337,000	22,186,227	40,533,395	62,719,622	12,411,088	30,640,643	27,558,637	156,333,990	
648,350	128,648,350	o	.....	.....	.....	.....	.....	.....	138,592,090	
239,516	109,456,121	3,783,395	14,973,940	63,954,437	78,928,377	8,135,291	4,498,124	21,677,724	.....	
776,855	454,474,776	347,302,079	.....	.....	.....	.....	.....	.....	753,903,290	
999,810	657,071,072	34,028,738	157,257,102	261,541,400	418,798,502	3,194,760	112,083,902	157,022,646	636,428,456	
058,697p	662,330,650p	15,028,047	o	165,798,413q	165,798,413	1,762,428q	444,595,067	56,974,739	632,715,867	
181,750	321,486,350	18,695,400	.....	.....	.....	.....	.....	.....	251,144,646	
582,737	315,254,040	328,697	92,731,635	154,164,644	246,896,279	189,609	21,166,891	47,329,958	289,903,699	
281,324	229,445,048	68,836,276	27,597,750	62,493,542	90,091,292	o	156,317,468	51,872,564	203,997,334	
110,700	166,110,700	o	49,975,154	73,421,298	123,396,452	o	23,666,176	19,048,072	160,624,600	
783,700	106,867,500	56,916,200	31,820,457	92,028,655	123,849,112	9,050,742	3,391,300	27,492,546	160,464,200	
402,996	122,030,190	26,372,806	10,073,836	94,472,433	104,546,269	u	18,567,657	25,289,070	152,681,540	
247,290	820,159,010	3,088,280	23,658,558	430,017,697	453,676,255	6,918,709	227,042,252	135,610,074	763,260,963	
593,985	476,350,485	1,243,500	37,159,337	264,447,814	301,607,151	40,274,523	80,279,263	55,433,048	460,097,505	
987,141	o	193,987,141	28,159,884	93,720,551	121,880,435	46,089,782	o	26,016,924	162,443,207	
991,200	182,247,990	843,210	52,135,225	75,568,797	127,704,022	34,702,660e	.....	20,684,518	183,091,200	
743,000	112,743,000	o	38,787,986	24,587,385	63,375,371	28,385,710	997,900	19,984,000	.....	
187,000k	92,365,000	169,822,000	27,331,854	122,406,995	149,738,849	23,693,454	39,454,315	49,300,382	225,453,000	

West South Central States

60,620 112,743,000

26,073a 262,187,000

n Generator Rating, Output, and Distribution of En
n Output Over 100,000,000 Kw.-Hr. During 1923 and

ated and Purchased Output 1924			Distribution of Energy in Kilowatt Hours 1924						Generated and P 19	
tal put Hr.	Generated Kw-Hr.	Purchased Kw-Hr.	Light	Power	Light and Power	Electric Railways	Other Public Utilities	Intra-Company Business and Line Losses, etc.	Total Output KW-Hr.	Gene Kw
459,887	549,118,300	15,341,587	.....	.....	364,870,347	8,351,440	61,617,963	129,620,137	526,465,178	509,
802,440	351,886,528	210,915,912	o	224,681,020	224,681,020	43,552,004	222,169,109	72,409,307	575,067,581	268,
626,000	278,187,000	11,439,000	43,017,000	107,685,000	150,702,000	398,000	89,594,000	40,590,000	373,504,000	359,
574,255	211,547,000	27,027,255	o	79,768,568	79,768,568	28,296,258	103,318,452	27,190,977	217,138,000	192,
558,428	198,541,780	29,016,648	29,235,644	112,140,699	141,376,343	18,835,628	24,559,431	8,992,824	196,432,892	129,
178,438	157,257,770	5,920,668	37,137,108	53,655,965	90,793,073	2,909,600	56,092,357	13,383,408	181,202,880	175,
117,396	145,561,076	8,556,320	23,567,720	71,737,530	95,305,250	11,591,128	2,031,703	45,189,315	147,136,310	133,
813,962	67,786,860	57,027,102	14,613,540	76,379,533	90,993,073	3,178,815	9,097,122	21,544,952	124,094,235	73,
814,400	123,814,400	o	12,303,695	75,370,128	87,673,823	1,099,084	16,444,160	16,295,084	133,707,946	133,
482,674	2,858,482,674	o	2,029,080	1,691,069,408	1,693,098,488	8,989,266	1,012,230,878	144,164,042	2,595,847,000	2,595,
432,473	2,055,459,073	973,400	.....	.....	1,179,740,790	229,810,026	307,250,289	339,631,184	1,899,679,975	1,897,
297,283	1,313,297,283	o	286,417,948	444,532,097	730,950,045	355,141,367	64,855,175	162,350,696	1,148,511,101	1,148,
240,840	1,128,357,890	69,882,950	287,433,603	452,214,021	739,647,624	220,586,264	615,300	237,391,652	1,084,990,294	1,053,
939,801	1,073,737,420	20,202,381	239,578,014	425,416,857	664,994,871	239,798,684	37,942,900	151,203,346	1,063,046,267	1,046,
609,902	994,413,228	1,196,674	97,295,486	620,732,388	718,027,874	79,405,699	42,442,843	155,733,486	945,691,000	944,
852,160	153,000,410	606,851,750	161,534,013	418,073,511	579,607,524	78,335,300	o	101,909,336	707,958,270	191,
454,633	88,890,815	632,563,818	.....	.....	162,558,134	83,827,686	380,525,787	94,543,026	707,087,842	159,
632,824	671,025,380	13,607,444	325,883,335c	155,386,515c	481,269,850	5,088,400	14,294,494	183,980,080	598,808,757	571,
923,200	540,823,800	90,099,400	72,881,892	432,927,187	505,809,079	40,470,855	12,813,330	71,829,936	602,691,800	509,
859,000	487,859,000	o	o	o	o	o	432,836,836	55,022,164	420,028,600	420,
143,909	266,466,290	145,677,619	32,748,707	122,312,454	155,061,161	99,014,422	95,354,927	62,713,399	380,630,188	300,
707,292	261,278,759	37,428,533	41,682,019	178,086,517	219,768,536	15,432,536	5,878,708	57,627,512	182,281,000	181,
223,754	230,012,020	37,211,734	108,986,282	64,577,769	173,564,051	41,797,859	6,163,269	45,698,575	248,156,900	210,
606,000	167,000,000	27,606,000	18,249,214	69,191,393	87,440,607	21,206,435	47,200,436	.....	168,814,810	147,
403,952	3,677,810	164,726,142	65,686,709	70,386,356	136,073,065	3,050,660	o	29,280,227	143,749,600	3,
364,793	164,185,034	1,179,759	21,012,907	95,801,311	116,814,218	1,236,118	11,773,213	35,541,244	147,423,930	146,
162,797	158,597,427	5,565,370	32,220,679	83,593,765	115,814,444	24,537,762	o	.....	.....	.....
275,257	105,822,689	38,452,568	17,864,134	47,573,869	65,438,003	2,293,815	47,054,906	29,488,533	130,921,606	122,
796,839	o	127,796,839	24,093,489	86,390,604	110,484,093	2,164,812	2,342,672	12,805,262	159,670,385	
334,269	94,862,800	26,471,469	160,623	49,832,718	49,993,341	o	52,328,657	19,012,271	.....	.....
696,496	109,625,096	1,071,400	2,661,728	38,344,794	41,006,522	o	59,633,538	10,056,436	115,661,600	108,
440,900	o	107,440,900	15,397,381d	46,987,874	62,385,255	18,862,075	6,372,720	19,820,850	100,205,700	
909,770	1,016,287,270	38,622,500	.....	.....	.....	.....	.....	.....	1,001,026,319	917,
307,210	352,598,510	295,708,700	.....	.....	498,200,599	150,106,611	o	o	678,346,746	407,
219,890	346,157,634	49,062,256	49,094,639	173,254,866	222,349,505	59,899,115	31,675,955	82,295,315	358,353,618	237,
695,035	286,688,808	6,227	90,058,157	54,221,042	144,279,199	81,606,414	2,448,335	58,361,087	269,870,850	269,
663,178	256,151,566	20,511,612	.....	.....	175,711,712	50,218,028	3,056,797	47,676,641	262,940,313	246,
300,000	243,500,000	900,000	6,811,482	194,186,516	200,997,998	12,000,000	9,404,000	21,900,000	244,600,000	244,
732,805	145,872,848	10,859,957	4,386,263	93,864,331	98,250,594	41,723,765e	.....	16,758,446	160,246,106	152,
012,957	147,984,957	28,000	o	94,908,023	94,908,023	o	36,935,479	16,169,455	163,147,137	162,
412,100	86,561,100	57,851,000	7,674,998	65,147,134	72,822,132	o	44,390,935	27,199,033	165,846,240	101,
946,221	141,134,955	811,266	15,133,711	92,158,140	107,291,851	6,308,000	4,863,372	22,937,000	112,820,766	106,
059,700	112,603,700	18,456,000	10,921,283	30,059,230	40,980,513	5,687,912	68,573,906	15,817,369	.....	.....
538,848	21,200,767	79,338,081	12,069,724	63,793,019	75,862,743	o	1,135,339	23,540,766	.....	.....
090,000	2,755,772,000	31,318,000	584,059,000	953,248,000	1,537,307,000	835,606,000	84,360,000	329,817,000	2,573,286,711	2,550
631,400	1,460,315,900	315,500	310,979,421	692,800,397	1,003,779,818	151,529,760	43,910,168	261,411,600	1,360,017,300	1,359
079,266	865,079,266	o	156,163,991	404,419,392	560,583,383	118,934,490	64,930,859	120,630,534	802,859,991	802
152,714	568,077,164	34,075,550	123,347,162	264,534,806	387,881,968	68,701,588	3,197,804	142,371,354	574,031,472	541
329,699	525,461,526	69,868,173	.....	.....	.....	.....	.....	.....	553,624,392	497
219,880	426,707,880	53,512,000	81,159,242	182,869,568	264,028,810	66,646,010	60,879,180	38,270,088	438,386,386	432
065,402h	480,533,975	33,975,000	81,027,543	201,923,334	282,950,877	49,768,432	39,182,442	91,202,044i	427,460,668	349
544,531	361,060,923	56,483,608	36,186,004	275,701,792	311,887,796	o	62,806,399	42,850,336	415,424,787	341
939,101j	321,832,125	20,106,976	49,649,388m	204,045,895	253,695,283	35,149,775	3,185,637	33,860,213	340,864,488	334
848,936	278,272,208	1,576,728	57,944,510	107,277,117	165,221,627	44,172,968	26,043,493	44,410,848	273,643,372	273
074,055	183,174,750	83,899,305	43,717,352	117,033,037	160,750,389	51,592,991	15,495,265	11,459,421	259,720,216	182
750,604	258,750,604	o	3,284	256,259,344	256,262,628	694,400	1,442,712	350,864	261,577,017	261
330,663	248,818,863	511,800	37,107,824	81,589,742	118,697,566	42,778,723	58,656,410	29,197,964	196,615,340	196
909,460	218,909,460	o	.....	.....	170,294,860	35,700,950	7,064,700	5,848,950	231,641,760	231
871,998	139,773,262	63,098,726	35,441,780	97,812,512	133,254,292	o	13,355,798	56,102,769	174,685,799	123
205,739	183,258,978	9,946,761	46,876,884l	68,126,066	115,002,950	4,766,022	25,425,632	47,011,145	148,000,000	133
810,339	181,810,339	o	20,796,244	104,043,495	124,839,739	o	14,370,931	42,599,669	169,453,319	169
220,978	113,630,385	35,590,593	26,554,930	85,051,688	111,606,618	11,121,250	6,897,581	19,495,529	.....	.....
285,527	98,174,915	38,110,612	33,003,619	51,328,496	84,332,115	24,866,789	6,766,912	20,319,711	146,987,474	103
329,990	122,992,990	337,000	22,186,227	40,533,395	62,719,622	12,411,088	30,640,643	27,558,637	156,333,990	156
648,350	128,648,350	o	.....	.....	.....	.....	.....	.....	138,592,090	138
239,516	109,456,121	3,783,395	14,973,940	63,954,437	78,928,377	8,135,291	4,498,124	21,677,724	.....	.....
776,855	454,474,776	347,302,079	.....	.....	.....	.....	.....	.....	753,903,290	.....
099,810	657,071,072	34,028,738	157,257,102	261,541,400	418,798,502	3,194,760	112,083,902	157,022,646	636,428,456	628
358,697p	662,330,650p	15,028,047	o	165,798,413q	165,798,413	1,762,428q	444,595,067	56,974,739	632,715,867	626
0,181,750	321,486,350	18,695,400	.....	.....	.....	.....	.....	.....	251,144,646	229
582,737	315,254,040	328,697	92,731,635	154,164,644	246,896,279	189,609	21,166,891	47,329,958	289,903,699	289
281,324	229,445,048	68,836,276	27,597,750	62,493,542	90,091,292	o	156,317,468	51,872,564	203,997,334	150
110,700	166,110,700	o	49,975,154	73,421,298	123,396,452	o	23,666,176	19,048,072	160,624,600	160
783,700	106,867,500	56,916,200	31,820,457	92,028,655	123,849,112	9,050,742	3,391,300	27,492,546	160,464,200	144
402,996	122,030,190	26,372,806	10,073,836	94,472,433	104,546,269	a	18,567,657	25,289,070	152,681,540	128
247,290	820,159,010	3,088,280	23,658,558	430,017,697	453,676,255	6,918,709	227,042,252	135,610,074	763,260,963	759
593,985	476,350,485	1,243,500	37,159,337	264,447,814	301,607,151	40,274,523	80,279,263	55,433,048	460,097,505	456
987,141	o	193,987,141	28,159,884	93,720,551	121,880,435	46,089,782	o	26,016,924	162,443,207	
091,200	182,247,990	843,210	52,135,225	75,568,797	127,704,022	34,702,660e	.....	20,684,518	183,091,200	182
743,000	112,743,000	o	38,787,986	24,587,385	63,375,371	28,385,710	997,900	19,984,000	.....	.....
187,000	92,365,000	169,822,000	27,331,854	122,406,995	149,738,849	23,693,454	39,454,315	49,300,382	225,453,000	71
757,000	257,755,000	2,000	16,526,748	63,977,260	80,504,008	o	161,614,035	15,638,957	240,662,700	240
			37,714,159	57,820,749	95,534,908	45,015,620	33,672,953	52,360,899	211,765,420	211
								22,027,389	129,318,120	129

East North Central States

45	Commonwealth Edison Company									
46	Detroit Edison Company						769,000a		2,787,090,000	2,755,73

262,187,000	92,365,000	169,822,000	27,331,854	122,406,995	149,738,849	23,693,454	39,454,315	49,300,382	225,453,000	

f Energy of All Companies
3 and 1924

Generated and Purchased Output 1923			Distribution of Energy In Kilowatt Hours 1923						Line Number
put r.	Generated Kw-Hr.	Purchased Kw-Hr.	Light	Power	Light and Power	Electric Railways	Other Public Utilities	Intra-Company Business and Line Losses, etc	
,178	509,916,900	16,548,278	.....	.....	332,205,025	9,211,768	64,607,112	120,441,273	1
,581	268,062,425	307,005,156	o	241,981,680	241,981,680	37,983,922	215,201,241	79,900,738	2
,000	359,746,000	13,758,000	37,233,000	99,326,000	136,559,000	336,490	156,000,000	80,609,510	3
,000	192,934,000	24,204,000	o	73,879,000	73,879,000	32,214,000	86,269,000	24,776,000	4
,892	129,646,404	66,786,488	25,431,350	94,241,915	119,673,265	21,355,054	16,350,673	39,053,900	5
,880	175,630,080	5,572,800	31,276,481	54,565,880	85,842,361	o	76,877,414	18,483,105	6
,310	133,405,850	13,730,460	22,814,272	72,941,487	95,755,759	14,000,000	788,060	35,592,491	7
,235	73,441,624	50,652,611	12,267,458	78,981,471	91,248,929	4,477,749	10,695,126	17,672,437	8
,946	133,707,946	o	10,709,466	105,215,664	115,925,130	1,496,490	o	16,286,326	9
,000	2,595,847,000	o	571,000	1,572,579,000	1,573,148,000	9,021,000	838,555,000	175,123,000	10
,975	1,897,844,955	1,835,020	.....	.....	1,070,476,938	228,912,665	29,697,319	570,593,053	11
,101	1,148,511,101	o	249,449,484	446,247,890	695,697,374	273,695,885	30,255,573	148,862,269	12
,294	1,053,906,064	31,084,230	239,863,721	424,925,206	664,788,927	190,168,465	554,500	229,478,402	13
,267	1,046,618,770	16,427,497	199,312,418	429,633,502	628,945,920	238,621,918	37,917,396	157,561,033	14
,000	944,563,000	1,128,000	78,249,000	597,337,000	675,586,000	80,210,000	35,219,000	154,676,000	15
,270	191,984,240	515,974,030	142,936,574	392,458,015	535,394,589	75,197,600	o	97,366,081	16
,842	159,389,476	547,698,366	.....	.....	150,780,062	90,099,278	372,667,980	93,540,522	17
,757	571,699,700	27,109,057	198,064,751	236,508,247	434,572,998	1,875,075	8,548,240	153,812,444	18
,800	509,851,700	92,840,100	62,312,206	401,021,186	463,333,392	49,816,716	14,698,747	74,842,945	19
,600	420,028,600	o	o	o	o	o	371,492,905	48,535,650	20
,188	300,816,187	79,814,001	23,391,530	124,922,014	148,313,549	95,424,840	67,345,818	69,545,981	21
,000	181,671,000	610,000	21,768,000	114,463,000	136,231,000	1,728,000	11,037,000	33,285,000	22
,900	210,064,128	38,092,772	88,210,585	67,059,742	155,270,327	41,266,328	8,410,445	43,209,800	23
,810	147,131,370	21,683,440	15,604,422	71,301,113	86,905,535	19,891,340	37,311,591	24,706,344	24
,600	3,560,400	140,188,660	51,497,937	64,601,632	116,099,569	2,894,080	o	24,755,411	25
,930	146,303,500	1,120,430	17,355,716	93,618,729	110,974,445	1,451,893	1,727,831	33,269,761	26
.....	.....	.....	.....	.....	.....	.....	.....	.....	27
,606	122,432,956	8,488,650	15,281,781	46,823,824	62,105,605	o	43,282,686	25,533,315	28
,385	o	159,670,385	25,166,499	113,766,809	138,933,308	2,523,669	4,424,240	13,789,168	29
.....	.....	.....	.....	.....	.....	.....	.....	.....	30
,600	108,250,700	7,410,900	2,259,938	45,559,191	47,819,129	o	58,488,871	9,353,600	31
,700	o	100,205,700	12,969,705	46,371,297	59,341,002	19,690,810	4,758,987	16,414,901	32
,319	917,470,340	83,555,979	.....	.....	578,995,398	.....	230,170,613	191,860,308	33
,746	407,495,046	270,851,700	112,943,652	342,122,117	455,065,769	148,823,926	o	74,447,051	34
,618	237,253,865	121,099,753	43,693,167	151,757,960	195,451,127	64,947,783	37,310,502	60,644,206	35
,850	269,865,217	5,633	82,915,304	48,323,776	131,239,080	92,038,864	2,200,300	44,392,606	36
,313	246,820,593	16,119,720	.....	.....	.....	.....	.....	.....	37
,000	244,600,000	o	5,500,000	195,000,000	200,500,000	o	20,000,000	24,100,000	38
,106	152,015,088	8,231,018	4,084,311	89,543,267	93,627,578	o	47,506,256	19,112,272	39
,137	162,853,900	293,237	o	103,774,977	103,774,977	o	46,008,652	13,363,508	40
,240	101,855,910	63,990,330	6,411,630	56,052,912	62,464,542	o	80,148,233	23,233,465	41
,766	106,998,443	5,822,323	7,625,180	75,954,401	83,579,581	6,386,735	o	22,854,450	42
....	.....	.....	.....	.....	.....	.....	.....	.....	43
....	.....	.....	.....	.....	.....	.....	.....	.....	44
,711	2,550,223,890	23,062,821	727,422,579	663,204,138	1,390,626,717	775,159,124	99,469,682	308,031,188	45
,300	1,359,910,800	106,500	267,693,195	670,784,067	938,477,262	148,284,370	40,114,483	233,141,185	46
,991	802,859,991	o	141,476,815	411,645,584	553,122,399	140,741,782	6,850,490	102,145,320	47
,472	541,803,447	32,228,025	105,143,241	267,783,891	372,927,132	67,409,463	2,825,979	130,868,898	48
,392	497,742,193	55,882,199	.....	.....	.....	.....	.....	.....	49
,386	432,578,388	5,808,000	70,239,342	174,912,444	245,151,786	59,748,329	48,185,329	49,221,220	50
,668	349,033,433	78,427,223	64,623,222	189,684,611	254,307,833	46,993,461	43,203,544	82,955,828	51
,787	341,211,837	74,212,950	30,468,495	298,318,218	328,786,713	o	47,603,822	39,034,252	52
,488	334,171,155	6,693,333	45,940,905	206,978,242	252,919,147	37,914,551	15,629,637	34,401,153	53
,372	273,643,372	o	50,150,359	116,254,727	166,405,086	44,340,779	7,964,180	54,933,327	54
,216	182,182,550	77,537,666	40,484,750	102,607,868	143,092,618	54,727,216	14,375,645	47,524,737	55
,017	261,577,017	o	2,960	260,094,004	260,096,964	687,400	443,900	348,753	56
,340	196,613,340	o	32,763,480	81,292,894	114,056,374	41,713,960	11,230,380	29,614,626	57
,760	231,641,760	o	48,413,440	101,347,068	149,760,508	33,894,346	o	47,986,906	58
,799	123,857,148	50,828,651	30,810,736	14,086,984	44,897,720	o	78,345,426	51,442,653	59
,000	133,000,000	15,000,000	43,000,000	55,000,000	98,000,000	600,000	20,000,000	29,400,000	60
,319	169,453,319	o	18,966,738	99,333,707	118,300,445	o	14,149,618	37,003,256	61
.....	.....	.....	.....	.....	.....	.....	.....	.....	62
,474	103,486,480	43,500,994	31,756,193	61,296,954	93,053,147	26,173,476	6,313,455	21,442,396	63
,990	156,333,990	o	20,762,956	58,985,646	79,748,602	12,447,939	36,606,902	27,536,547	64
,090	138,592,090	o	.....	.....	.....	.....	.....	.....	65
....	.....	.....	.....	.....	.....	.....	.....	.....	66
,290	.....	.....	.....	.....	.....	.....	.....	.....	
,456	628,312,834	8,115,622	139,116,128	252,068,128	391,184,256	5,868,260	109,119,138	130,256,802	68
,867	626,463,950	6,251,917	o	149,515,447	149,515,447	o	421,461,193	61,739,227	69
,646	229,271,245	21,873,401	31,585,000	145,775,000	177,360,000	21,260,000	9,190,000	45,807,056	70
,699	289,527,135	376,564	85,214,844	143,179,804	228,394,648	355,823	15,157,318	45,995,910	71
,334	150,798,086	53,199,248	15,141,024	18,805,773	33,946,797	o	140,232,789	29,817,748	72
,600	160,624,600	o	42,246,350	75,289,782	117,536,132	o	22,191,100	20,897,368	73
,200	144,477,200	15,987,000	29,453,841	90,358,355	119,812,246	9,301,768	3,359,778	27,990,408	74
,540	128,144,100	24,537,440	9,270,631	86,487,936	95,758,567	o	27,872,800	29,050,173	75
,963	759,758,358	3,502,605	17,619,838	380,585,528	398,205,366	25,000,000	204,379,569	135,676,028	76
,505	456,993,605	3,103,900	14,407,115	180,966,282	195,373,397	14,042,880	187,122,610	63,558,618	77
,207	o	162,443,207	28,000,000	68,000,000	96,000,000	65,826,992	o	616,215	78
,200	182,247,990	843,210	52,135,225	75,568,797	127,704,022	34,702,660	.....	20,684,518	79
....	.....	.....	.....	.....	.....	.....	.....	.....	80
,000	71,547,000	153,906,000	24,634,846	82,448,889	107,083,735	24,634,846	82,448,889	38,059,405	81
,700	240,656,700	6,000	16,158,114	58,484,772	74,642,886	o	150,129,994	15,889,820	82
,420	211,765,420	o	35,054,564	54,888,334	89,942,898	o	31,543,277	90,279,245	83
,120	129,318,120	o	24,196,270	83,215,567	107,411,837	2,702,975	146,223	19,057,085	84
.....	.....	.....	.....	.....	.....	.....	.....	.....	85
,000	2,755,772,000	31,318,000	584,059,000	953,248,000	1,537,307,000	835,606,000	84,360,000	329,817,000	2,573,286,711
,000	1,460,315,900	315,500	310,979,421	692,800,397	1,003,779,818	151,529,760	43,910,168	261,411,600	1,360,017,300
	865,079,266								

2,187,000	92,365,000	169,822,000	27,331,854	122,406,995	149,738,849	39,454,315	49,500,382			
7,757,000	257,755,000	2,000	16,526,748	63,977,260	80,504,008	0	161,614,035	15,638,957	240,662,700	
			37,714,159	57,820,749	95,534,908	45,015,620	33,672,953	52,360,899	211,765,420	
								22,927,389	129,318,120	

East North Central States

Line Number	Section and System	Generator Rating: Total Fuel Burning Plants Jan. 1, 1925 Kva	Generator Rating: Total Hydro Plants Jan. 1, 1925 Kva	Generated an: Total Output Kw.-Hr.	G
45	Commonwealth Edison Company	769,000a	0	2,787,090,000	2,75
46	Detroit Edison Company	453,000a	5,850a	1,460,631,400	1,46
47	Cleveland Electric Illuminating Company	360,000	0	865,079,266	86
48	Consumers Power Company	136,906	102,937	602,152,714	56
49	Milwaukee Group (North American Company)	226,425	15,725f	595,329,699	52
50	Union Gas and Electric Company	112,000	0	480,219,880	42
51	Public Service Company of Northern Illinois	147,615ag	4,100a	514,065,402h	48
52	Ohio Public Service Company	170,125	760	417,544,531	36
53	Pennsylvania—Ohio Power and Light Company	93,800	1,250	341,939,101j	32
54	Toledo Edison Company	143,540	11,950	279,848,936	27
55	Northern Ohio Traction and Light Company	67,000a	2,175a	267,074,055	18
56	Michigan Northern Power Company	0	45,600k	258,750,604	25
57	Dayton Power and Light Company	125,280	0	249,330,663	24
58	Columbus Railway, Power and Light Company	84,000	0	218,909,460	21
59	Central Illinois Public Service Company	81,415	0	202,871,998	13
60	American Public Utilities Company	97,980	480	193,205,739	18
61	Indianapolis Light and Heat Company	84,500	0	181,810,339	18
62	Northern Indiana Gas and Electric Company	42,600	0	149,220,978	11
63	United Light and Power Company	86,300	5,800	136,285,527	9
64	Indiana and Michigan Electric Company	24,000a	21,700a	133,329,990	13
65	Cleveland Municipal Electric Light System	42,000	0	128,648,350	12
66	Wisconsin Public Service Corporation	16,250a	30,900	113,239,516	10
	West North Central States				
67	St. Louis and East St. Louis Group (North American Company)	241,850	72,000n	801,776,855	45
68	Northern States Power Company	272,704o	121,378o	691,099,810	65
69	Mississippi River Power Company	0	139,000	677,358,697p	66
70	Minnesota Power and Light Company	14,450a	82,665a	340,181,750	32
71	Kansas City Power and Light Company	136,682	0	315,582,737	31
72	North West Utilities Company	33,995a	48,982a	298,281,324	22
73	Nebraska Power Company	53,000a	0	166,110,700	16
74	Kansas Gas and Electric Company	44,190a	550a	163,783,700	10
75	Empire District Electric Company	59,635	4,750	148,402,996	12
	East South Central States				
76	Alabama Power Company	176,408r	159,025	823,247,290	82
77	Tennessee Electric Power Company	115,087	120,505	477,593,985	47
78	Birmingham Electric Company	11,700a	0	193,987,141	
79	Louisville Gas and Electric Company	.....	.....	183,091,200	18
80	Memphis Power and Light Company	60,620	.....	112,743,000	11
	West South Central States				
81	Texas Power and Light Company	26,073a	0	262,187,000	
82	Fort Worth Power and Light Company	44,000a	0	257,757,000	25
83	New Orleans Public Service Company	112,750	0	226,584,380	22
84	Houston Lighting and Power Company	72,500a	0	161,307,120	16
85	Oklahoma Gas and Electric Company (System)	55,000	0	129,946,323	10
86	Dallas Power and Light Company	35,500a	0	127,924,350	
	Mountain States				
87	Montana Power Company	810	211,530	1,121,245,976	1,1
88	Utah Power and Light Company	36,450a	155,222a	749,653,000	68
89	Idaho Power Company	0	59,500a	218,464,000	21
90	Public Service Company of Colorado	58,000	31,300	216,151,037	21
	Pacific States				
91	Pacific Gas and Electric Company	142,000a	317,975a	1,887,113,680	1,71
92	Southern California Edison Company	150,450a	278,150a	1,664,151,512	1,44
93	Great Western Power Company of California	30,075	131,000	617,482,000	61
94	Puget Sound Power and Light Company	33,850a	106,895a	607,067,218	53
95	San Joaquin Light and Power Corporation	54,050	84,600	573,821,266v	52
96	Los Angeles Bureau of Power and Light	0	86,856	437,209,701	18
97	Washington Water Power Company	0	127,750a	426,053,680	41
98	Portland Electric Power Company	36,500a	78,730a	394,013,720	39
99	Los Angeles Gas and Electric Corporation	73,700a	0	245,047,430	24
100	Southern Sierras Power Companyw	13,418	66,495	226,680,958	19
101	Northwestern Electric Company	25,000a	15,000	188,771,500	14
102	California Oregon Power Company	0	40,560v	180,554,058	17
103	Seattle Municipal Light and Power System	30,000	75,000	152,125,000	14
104	Tacoma Light and Power System	11,250	24,000	147,218,203	15
105	Western States Gas and Electric Company	9,720	35,000	140,899,810	
106	Pacific Power and Light Company	8,175a	20,475a	137,304,890	10
	Canada				
107	Hydro-Electric Power Commission of Ontariox	15,000	730,092	3,026,615,156	2,8
108	Shawinigan Water and Power Company	.....	322,450	2,066,066,762	1,6
109	Montreal Light, Heat and Power Consolidated	.....	.....	1,210,105,965	8
110	British Columbia Electric Railway Company, Limitedy	12,500	91,600	300,456,350	
111	Winnipeg Hydro-Electric System	13,750	57,000	200,520,080	2
	Electric Railways				
112	Interborough Rapid Transit Company	390,000	0	1,019,620,637	1,0
113	Chicago Surface Lines	0	0	604,581,618	
114	Williamsburgh Power Plant Corporation	209,100	a	478,911,990	4
115	Philadelphia Rapid Transit Company	65,775	0	371,519,687	
116	Boston Elevated Railway	182,000	0	261,091,060	2
117	Pennsylvania Railroad (Long Island Plant)	105,000	0	244,058,440	2
118	Pacific Electric Railway Company	0	0	185,000,000	
119	New York Central Railroad	90,000	0	173,938,625z	1
120	Twin City Rapid Transit Company	65,000	15,000	143,000,000	1
121	Kansas City Railways Company	53,000kw	0	129,383,860	1
122	Chicago, Milwaukee and St. Paul Railroad	.....	.....	116,974,000	...

a—Kilowatts.
b—95,000 kw.
c—Estimated.
d—Includes 2,201,650 kw.-hr. sold for street lighting.
e—Includes energy sold to other public utilities.
f—15,000 kw. purchased hydro.
g—Includes 6,000 kw. operated jointly with the Commonwealth Edison Company.
h—Includes 50,961,607 kw.-hr. generated jointly with the Commonwealth Edison Company.
i—Includes 320,212 kw.-hr. in leased lines.
j—Includes 6,048,193 kw.-hr. used in generating plant for light and power.
k—Exclusi
l—Includes lighting.
m—Includ
n—Purcha

	2,715,772,000	91,240,000	584,050,000	953,248,000	1,537,307,000	835,606,000	84,360,000	539,245,000	2,573,286,744	2,559,231

1,765,420	211,765,420	o	35,054,564	54,888,334	89,942,898	o	31,545,277	30,279,249	85	
9,318,120	129,318,120	o	24,196,270	83,215,567	107,411,837	2,702,975	146,223	19,057,085	84	
									85	
						33,369,728	14,308	12,601,167	86	
90,000	2,755,772,000	31,318,000	584,059,000	953,248,000	1,537,307,000	835,606,000	84,360,000	329,817,000	2,573,286,711	2,5
31,400	1,460,315,900	315,500	310,979,421	692,800,397	1,003,779,818	151,529,760	43,910,168	261,411,600	1,360,017,300	1,3
79,266	865,079,266	o	156,163,991	404,419,392	560,583,383	118,934,490	64,930,859	120,630,534	802,859,991	8
52,714	568,077,164	34,075,550	123,347,162	264,534,806	387,881,968	68,701,588	3,197,804	142,371,354	574,031,472	5
29,699	525,461,526	69,868,173							553,624,392	4
19,880	426,707,880	53,512,000	81,159,242	182,869,568	264,028,810	66,646,010	60,879,180	38,270,088	438,386,386	4
65,402*k*	480,533,975	33,975,000	81,027,543	201,923,334	282,950,877	49,768,432	39,182,442	91,202,044*i*	427,460,668	3
44,531	361,060,923	56,483,608	36,186,004	275,701,792	311,887,796	o	62,806,399	42,850,336	415,424,787	3
39,101*j*	321,832,125	20,106,976	49,649,388*m*	204,045,895	253,695,283	35,149,775	3,185,637	33,860,213	340,864,488	3
48,936	278,272,208	1,576,728	57,944,510	107,277,117	165,221,627	44,172,968	26,043,493	44,410,848	273,643,372	2
74,055	183,174,750	83,899,305	43,717,352	117,033,037	160,750,389	51,592,991	15,495,265	11,459,421	259,720,216	1
50,604	258,750,604	o	3,284	256,259,344	256,262,628	694,400	1,442,712	350,864	261,577,017	2
30,663	248,818,863	511,800	37,107,824	81,589,742	118,697,566	42,778,723	58,656,410	29,197,964	196,615,340	1
09,460	218,909,460	o			170,294,860	35,700,950	7,064,700	5,848,950	231,641,760	2
71,998	139,773,262	63,098,726	35,441,780	97,812,512	133,254,292	o	13,355,798	56,102,769	174,685,799	1
05,739	183,258,978	9,946,761	46,876,884*l*	68,126,066	115,002,950	4,766,022	25,425,632	47,011,145	148,000,000	1
10,339	181,810,339	o	20,796,244	104,043,495	124,839,739	o	14,370,931	42,599,669	169,453,319	1
20,978	113,630,385	35,590,593	26,554,930	85,051,688	111,606,618	11,121,250	6,897,581	19,495,529		
85,527	98,174,915	38,110,612	33,003,619	51,328,496	84,332,115	24,866,789	6,766,912	20,319,711	146,987,474	1
29,990	132,992,990	337,000	22,186,227	40,533,395	62,719,622	12,411,088	30,640,643	27,558,637	156,333,990	1
48,350	128,648,350	o							138,592,090	1
39,516	109,456,121	3,783,395	14,973,940	63,954,437	78,928,377	8,135,291	4,498,124	21,677,724		
76,855	454,474,776	347,302,079							753,903,290	
99,810	657,071,072	34,028,738	157,257,102	261,541,400	418,798,502	3,194,760	112,083,902	157,022,646	636,428,456	6
58,697*p*	662,330,650*p*	15,028,047	o	165,798,413*q*	165,798,413	1,762,428*q*	444,595,067	56,974,739	632,715,867	6
81,750	321,486,350	18,695,400							251,144,646	2
82,737	315,254,040	328,697	92,731,635	154,164,644	246,896,279	189,609	21,166,891	47,329,958	289,903,699	2
81,324	229,445,048	68,836,276	27,597,750	62,493,542	90,091,292	o	156,317,468	51,872,564	203,997,334	1
10,700	166,110,700	o	49,975,154	73,421,298	123,396,452	o	23,666,176	19,048,072	160,624,600	1
83,700	106,867,500	56,916,200	31,820,457	92,028,655	123,849,112	9,050,742	3,391,300	27,492,546	160,464,200	1
02,996	122,030,190	26,372,806	10,073,836	94,472,433	104,546,269	o	18,567,657	25,289,070	152,681,540	1
47,290	820,159,010	3,088,280	23,658,558	430,017,697	453,676,255	6,918,709	227,042,252	135,610,074	763,260,963	7
93,985	476,350,485	1,243,500	37,159,337	264,447,814	301,607,151	40,274,523	80,279,263	55,433,048	460,097,505	4
87,141	o	193,987,141	28,159,884	93,720,551	121,880,435	46,089,782	o	26,016,924	162,443,207	
91,200	182,247,990	843,210	52,135,225	75,568,797	127,704,022	34,702,660*e*		20,684,518	183,091,200	1
43,000	112,743,000	o	38,787,986	24,587,385	63,375,371	28,385,710	997,900	19,984,000		
87,000	92,365,000	169,822,000	27,331,854	122,406,995	149,738,849	23,693,454	39,454,315	49,300,382	225,453,000	
57,000	257,755,000	2,000	16,526,748	63,977,260	80,504,008	o	161,614,035	15,638,957	240,662,700	2
84,380	226,584,380	o	37,714,159	57,820,749	95,534,908	45,015,620	33,672,953	52,360,899	211,765,420	2
07,120	161,233,220	73,900	26,996,091	107,783,203	134,779,294	3,439,335	161,102	22,927,389	129,318,120	
46,323	109,999,893	19,946,430	37,986,915	48,842,177	86,829,092	2,995,056	4,588,126	35,534,049		
24,350	96,197,900	31,726,450	36,756,745	33,801,881	70,558,626	37,448,650	1,649,507	18,267,567	105,400,728	
45,976	1,116,914,948	4,331,028	34,576,757*s*	778,864,495	813,441,252	116,974,186	26,118,102	164,712,436	1,122,750,450	1,
53,000	680,546,000	69,107,000	63,300,077	512,246,217	575,546,294	53,044,948	974,228	120,087,530	621,977,000	
64,000	215,629,000	2,835,000	71,203,999	86,330,548	157,534,547	4,884,791	4,998,572	51,046,090	222,590,000	
51,037	216,151,037	o	66,777,834	85,412,812	152,190,646	2,164,050	12,922,007	48,874,334	145,302,874	
13,680	1,710,388,801	176,724,879	196,230,710	718,580,870	914,811,580	262,177,508	154,909,871	555,214,721	1,725,619,492	1,
51,512	1,442,298,975	221,852,537	118,345,984	907,040,722	1,025,386,706	305,394,854	21,809,354	311,560,598	1,548,896,120	1,
82,000	615,482,000	2,000,000	64,726,000	291,246,000	355,972,000	28,439,000	51,303,000	181,768,000	589,597,024	
67,218	534,650,935	72,416,283			485,003,981	36,566,389	2,512,203*t*	82,984,645*u*	577,578,440	
21,266*v*	524,151,130	49,670,136	44,762,068	267,745,112	312,507,180	4,646,381	146,673,600*v*	109,994,105	465,458,706	
09,701	189,574,150	247,635,551	144,607,174	211,192,159	355,799,333	o	120,005*t*	81,290,363	426,337,964	
53,680	417,545,400	8,508,280			241,771,044	49,336,102	66,339,093	68,607,441	413,240,900	
13,720	393,873,700	140,020	49,007,894	159,722,950	208,730,844	26,366,197	4,770,644	154,146,035	365,997,750	
47,430	244,926,177	121,253	81,795,924	48,351,176	130,147,100	o	86,206,200	28,694,130	127,357,201	
80,958	193,480,000	33,200,958	7,497,582	155,627,763	163,125,345	o	6,830,300	56,725,313	219,653,900	
71,500	143,052,700	35,718,800	21,686,818	122,094,268	143,781,086	o	573,980	34,416,434	152,702,800	
54,058	175,778,058	4,776,000	19,440,788	40,796,553	60,237,341	o	73,096,940	47,219,777	153,500,531	
25,000	147,306,000	4,819,000							115,431,550	
18,203	130,611,635	16,606,568	34,114,457	63,419,813	97,534,270	1,055,360	4,966,248	43,662,325	136,757,822	
99,810	93,941,303	46,651,507	19,558,336	75,903,953	95,462,289	7,692,883	13,029,984	24,714,654		
04,890	105,420,249	31,884,641	21,830,247	43,989,794	65,820,041	1,803,290	38,743,860	30,937,699	116,676,395	
15,156	2,890,780,651	135,834,505							2,906,519,819	2,
66,762	1,606,146,062	459,920,700			1,370,625,241	o	456,090,976	239,350,545	1,667,397,876	1,
05,965	860,752,495	349,353,470							1,089,099,507	
56,350	1,145,400	299,310,950							129,548,600	
20,080	200,520,080	o	112,470,026	33,593,636	146,063,662	o	3,258,200	51,198,218	164,609,860	
20,637	1,019,588,610*z*	32,027	o	922,850	922,850	788,365,483*A*	599		960,340,481	
81,618	o	604,581,618				604,581,618			576,457,370	
11,990	478,779,990	132,000				478,911,990			449,827,266	
19,687	98,311,429	273,208,258				371,519,687			383,313,078	
91,060	261,091,060	o				261,091,060			257,983,320	
58,440	243,287,293	1,058,440				147,255,030			244,113,039	
00,000	o	185,000,000				185,000,000			198,211,000	
38,625*z*	173,938,625*z*	o				173,938,625			163,895,940	
00,000	143,000,000	o				143,000,000			146,605,919	
83,860	129,383,860	o	o	74,366	74,366	128,914,438*R*	395,056		128,302,450	
74,000		116,974,000				116,974,000			122,643,791	

Generated and Purchased Output 1924 | **Distribution of Energy in Kilowatt Hours 1924** | **Generated a**

tal put -Hr.	Generated Kw-Hr.	Purchased Kw-Hr.	Light	Power	Light and Power	Electric Railways	Other Public Utilities	Intra-Company Business and Line Losses, etc.	**Total Output KW-Hr.**	

k—Exclusive of exciters.
l—Includes cooking, heating and street lighting.
m—Includes domestic cooking.
n—Purchased hydroelectric.
o—Horsepower.
p—Includes station current.
q—Wholesale only.
r—Includes 70,500 kw. leased from Government at Sheffield.
s—Includes domestic heating.
t—Company's steam, gas and water departments.
u—Transmission and conversion losses.
v—Includes power received for transmission Southern California Edison Company.
w—Includes Ne pany and Desert Company.
x—Includes Ont
y—Includes Va

1	2,550,223,890	23,062,821	727,422,579	663,204,138	1,390,626,717	775,159,124	99,469,682	308,031,188	45	
	2,360,010,800	106,500	267,693,195	670,784,067	938,477,262	148,284,370	40,114,483	233,141,185	47	

Generated and Purchased Output 1924			Distribution of Energy in Kilowatt Hours 1924						Generated and P 19	
otal tput -Hr.	Generated Kw-Hr.	Purchased Kw-Hr.	Light	Power	Light and Power	Electric Railways	Other Public Utilities	Intra-Company Business and Line Losses, etc.	Total Output KW-Hr.	Gene Kw
90,000	2,755,772,000	31,318,000	584,059,000	953,248,000	1,537,307,000	835,606,000	84,360,000	329,817,000	2,573,286,711	2,550,
31,400	1,460,315,900	315,500	310,979,421	692,800,397	1,003,779,818	151,529,760	43,910,168	261,411,600	1,360,017,300	1,359,
79,266	865,079,266	*o*	156,163,991	404,419,392	560,583,383	118,934,490	64,930,859	120,630,534	802,859,991	802,
52,714	568,077,164	34,075,550	123,347,162	264,534,806	387,881,968	68,701,588	3,197,804	142,371,354	574,031,472	541,
29,699	525,461,526	69,868,173	.....	.....	.....	.....	.....	.....	553,624,392	497,
19,880	426,707,880	53,512,000	81,159,242	182,869,568	264,028,810	66,646,010	60,879,180	38,270,088	438,386,386	432,
65,402*h*	480,533,975	33,975,000	81,027,543	201,923,334	282,950,877	49,768,432	39,182,442	91,202,044*i*	427,460,668	349,
44,531	361,060,923	56,483,608	36,186,004	275,701,792	311,887,796	*o*	62,806,399	42,850,336	415,424,787	341,
39,101*j*	321,832,125	20,106,976	49,649,388*m*	204,045,895	253,695,283	35,149,775	3,185,637	33,860,213	340,864,488	334,
48,936	278,272,208	1,576,728	57,944,510	107,277,117	165,221,627	44,172,968	26,043,493	44,410,848	273,643,372	273,
74,055	183,174,750	83,899,305	43,717,352	117,033,037	160,750,389	51,592,991	15,495,265	11,459,421	259,720,216	182,
50,604	258,750,604	*o*	3,284	256,259,344	256,262,628	694,400	1,442,712	350,864	261,577,017	261,
30,663	248,818,863	511,800	37,107,824	81,589,742	118,697,566	42,778,723	58,656,410	29,197,964	196,615,340	196,
09,460	218,909,460	*o*	.....	.....	170,294,860	35,700,950	7,064,700	5,848,950	231,641,760	231,
71,998	139,773,262	63,098,726	35,441,780	97,812,512	133,254,292	*o*	13,355,798	56,102,769	174,685,799	123,
05,739	183,258,978	9,946,761	46,876,884*l*	68,126,066	115,002,950	4,766,022	25,425,632	47,011,145	148,000,000	133,
10,339	181,810,339	*o*	20,796,244	104,043,495	124,839,739	*o*	14,370,931	42,599,669	169,453,319	169,
20,978	113,630,385	35,590,593	26,554,930	85,051,688	111,606,618	11,121,250	6,897,581	19,495,529	.....	.....
85,527	98,174,915	38,110,612	33,003,619	51,328,496	84,332,115	24,866,789	6,766,912	20,319,711	146,987,474	103,
29,990	132,992,990	337,000	22,186,227	40,533,395	62,719,622	12,411,088	30,640,643	27,558,637	156,333,990	156,
48,350	128,648,350	*o*	.....	.....	.....	.....	.....	.....	138,592,090	138,
39,516	109,456,121	3,783,395	14,973,940	63,954,437	78,928,377	8,135,291	4,498,124	21,677,724	.....	.....
76,855	454,474,776	347,302,079	.....	.....	.....	.....	.....	.....	753,903,290	.....
99,810	657,071,072	34,028,738	157,257,102	261,541,400	418,798,502	3,194,760	112,083,902	157,022,646	636,428,456	628,
58,697*p*	662,330,650*p*	15,028,047	*o*	165,798,413*q*	165,798,413	1,762,428*q*	444,595,067	56,974,739	632,715,867	626,
81,750	321,486,350	18,695,400	.....	.....	.....	.....	.....	.....	251,144,646	229,
82,737	315,254,040	328,697	92,731,635	154,164,644	246,896,279	189,609	21,166,891	47,329,958	289,903,699	289,
81,324	229,445,048	68,836,276	27,597,750	62,493,542	90,091,292	*o*	156,317,468	51,872,564	203,997,334	150,
10,700	166,110,700	*o*	49,975,154	73,421,298	123,396,452	*u*	23,666,176	19,048,072	160,624,600	160,
83,700	106,867,500	56,916,200	31,820,457	92,028,655	123,849,112	9,050,742	3,391,300	27,492,546	160,464,200	144,
02,996	122,030,190	26,372,806	10,073,836	94,472,433	104,546,269	*u*	18,567,657	25,289,070	152,681,540	128,
47,290	820,159,010	3,088,280	23,658,558	430,017,697	453,676,255	6,918,709	227,042,252	135,610,074	763,260,963	759,
93,985	476,350,485	1,243,500	37,159,337	264,447,814	301,607,151	40,274,523	80,279,263	55,433,048	460,097,505	456,
87,141	*o*	193,987,141	28,159,884	93,720,551	121,880,435	46,089,782	*o*	26,016,924	162,443,207	
91,200	182,247,990	843,210	52,135,225	75,568,797	127,704,022	34,702,660*v*	.....	20,684,518	183,091,200	182,
43,000	112,743,000	*o*	38,787,986	24,587,385	63,375,371	28,385,710	997,900	19,984,000	.....	.....
87,000	92,365,000	169,822,000	27,331,854	122,406,995	149,738,849	23,693,454	39,454,315	49,300,382	225,453,000	71,
57,000	257,755,000	2,000	16,526,748	63,977,260	80,504,008	*o*	161,614,035	15,638,957	240,662,700	240,
84,380	226,584,380	*o*	37,714,159	57,820,749	95,534,908	45,015,620	33,672,953	52,360,899	211,765,420	211,
07,120	161,233,220	73,900	26,996,091	107,783,203	134,779,294	3,439,335	161,102	22,927,389	129,318,120	129,
46,323	109,999,893	19,946,430	37,986,915	48,842,177	86,829,092	2,995,056	4,588,126	35,534,049	.....	.....
24,350	96,197,900	31,726,450	36,756,745	33,801,881	70,558,626	37,448,650	1,649,507	18,267,567	105,400,728	55,
45,976	1,116,914,948	4,331,028	34,576,757*s*	778,864,495	813,441,252	116,974,186	26,118,102	164,712,436	1,122,750,450	1,122,
53,000	680,546,000	69,107,000	63,300,077	512,246,217	575,546,294	53,044,948	974,228	120,087,530	621,977,000	621,
64,000	215,629,000	2,835,000	71,203,999	86,330,548	157,534,547	4,884,791	4,998,572	51,046,090	222,590,000	210,
51,037	216,151,037	*o*	66,777,834	85,412,812	152,190,646	2,164,050	12,922,007	48,874,334	145,302,874	70,
13,680	1,710,388,801	176,724,879	196,230,710	718,580,870	914,811,580	262,177,508	154,909,871	555,214,721	1,725,619,492	1,580,
51,512	1,442,298,975	221,852,537	118,345,984	907,040,722	1,025,386,706	305,394,854	21,809,354	311,560,598	1,548,896,120	1,464,
82,000	615,482,000	2,000,000	64,726,000	291,246,000	355,972,000	28,439,000	51,303,000	181,768,000	589,597,024	575,
67,218	534,650,935	72,416,283	.....	.....	485,003,981	36,566,389	2,512,203*t*	82,984,645*u*	577,578,440	503,
21,266*e*	524,151,130	49,670,136	41,762,068	267,745,112	312,507,180	4,646,381	146,673,600*v*	109,994,105	465,458,706	465,
09,701	189,574,150	247,635,551	144,607,174	211,192,159	355,799,333	*o*	120,005*t*	81,290,363	426,337,964	251,
53,680	417,545,400	8,508,280	.....	.....	241,771,044	49,336,102	66,339,093	68,607,441	413,240,900	407,
13,720	393,873,700	140,020	49,007,894	159,722,950	208,730,844	26,366,197	4,770,644	154,146,035	365,997,750	365,
47,430	244,926,177	121,253	81,795,924	48,351,176	130,147,100	*o*	86,206,200	28,694,130	127,357,201	126,
80,958	193,480,000	33,200,958	7,497,582	155,627,763	163,125,345	*o*	6,830,300	56,725,313	219,653,900	206,
71,500	143,052,700	35,718,800	21,686,818	122,094,268	143,781,086	*o*	573,980	34,416,434	152,702,800	131,
54,058	175,778,058	4,776,000	19,440,788	40,796,553	60,237,341	*o*	73,096,940	47,219,777	153,500,531	152,
25,000	147,306,000	4,819,000	.....	.....	.....	.....	.....	.....	115,431,550	114,
18,203	130,611,635	16,606,568	34,114,457	63,419,813	97,534,270	1,055,360	4,966,248	43,662,325	136,757,822	128,
99,810	93,941,303	46,251,507	19,558,336	75,903,953	95,462,289	7,692,883	13,029,984	24,714,654	.....	.....
04,890	105,420,249	31,884,641	21,830,247	43,989,794	65,820,041	1,803,290	38,743,860	30,937,699	116,676,395	93,
15,156	2,890,780,651	135,834,505	.....	.....	.....	.....	.....	.....	2,906,519,819	2,707,
66,762	1,606,146,062	459,920,700	.....	.....	1,370,625,241	*o*	456,090,976	239,350,545	1,667,397,876	1,199,
05,965	860,752,495	349,353,470	.....	.....	.....	.....	.....	.....	1,089,099,507	836,
56,350	1,145,400	299,310,950	.....	.....	.....	.....	.....	.....	129,548,600	129,
20,080	200,520,080	*o*	112,470,026	33,593,636	146,063,662	*o*	3,258,200	51,198,218	164,609,860	164,
20,637	1,019,588,610*z*	32,027	*o*	922,850	922,850	788,365,483*A*	599	.....	960,340,481	960,
81,618	*o*	604,581,618	.....	.....	.....	604,581,618	.....	.....	576,457,370	
11,990	478,779,990	132,000	.....	.....	.....	478,911,990	.....	.....	449,827,266	449,
19,687	98,311,429	273,208,258	.....	.....	.....	371,519,687	.....	.....	383,313,078	154,
91,060	261,091,060	*o*	.....	.....	.....	261,091,060	.....	.....	257,983,320	257,
58,440	243,287,293	1,058,440	.....	.....	.....	147,255,030	.....	.....	244,113,039	243,
00,000	*o*	185,000,000	.....	.....	.....	185,000,000	.....	.....	198,211,000	
38,625*z*	173,938,625*z*	*o*	.....	.....	.....	173,938,625	.....	.....	163,895,940	163,
00,000	143,000,000	*o*	.....	.....	.....	143,000,000	.....	.....	146,605,919	104,
83,860	129,383,860	*o*	*o*	74,366	74,366	128,914,438*R*	395,056	.....	128,302,450	128,
74,000	.....	116,974,000	.....	.....	.....	116,974,000	.....	.....	122,643,791	

k—Exclusive of exciters.
l—Includes cooking, heating and street lighting.
m—Includes domestic cooking.
n—Purchased hydroelectric.
o—Horsepower.
p—Includes station current.
q—Wholesale only.
r—Includes 70,500 kw. leased from Government at Sheffield.
s—Includes domestic heating.
t—Company's steam, gas and water departments.
u—Transmission and conversion losses.
v—Includes power received for transmission Southern California Edison Company.
w—Includes Nevad pany and Desert W Company.
x—Includes Ontario
y—Includes Vancou

Generated and Purchased Output 1923			Distribution of Energy In Kilowatt Hours 1923						
put .	Generated Kw-Hr.	Purchased Kw-Hr.	Light	Power	Light and Power	Electric Railways	Other Public Utilities	Intra-Company Business and Line Losses, etc.	Line Number
,711	2,550,223,890	23,062,821	727,422,579	663,204,138	1,390,626,717	775,159,124	99,469,682	308,031,188	45
,300	1,359,910,800	106,500	267,693,195	670,784,067	938,477,262	148,284,370	40,114,483	233,141,185	46
,991	802,859,991	o	141,476,815	411,645,584	553,122,399	140,741,782	6,850,490	102,145,320	47
,472	541,803,447	32,228,025	105,143,241	267,783,891	372,927,132	67,409,463	2,825,979	130,868,898	48
,392	497,742,193	55,882,199	.....	.....	.....	.....	.....	.....	49
,386	432,578,388	5,808,000	70,239,342	174,912,444	245,151,786	59,748,329	48,185,329	49,221,220	50
,668	349,033,433	78,427,223	64,623,222	189,684,611	254,307,833	46,993,461	43,203,544	82,955,828	51
,787	341,211,837	74,212,950	30,468,495	298,318,218	328,786,713	o	47,603,822	39,034,252	52
,488	334,171,155	6,693,333	45,940,905	206,978,242	252,919,147	37,914,551	15,629,637	34,401,153	53
,372	273,643,372	o	50,150,359	116,254,727	166,405,086	44,340,779	7,964,180	54,933,327	54
,216	182,182,550	77,537,666	40,484,750	102,607,868	143,092,618	54,727,216	14,375,645	47,524,737	55
,017	261,577,017	o	2,960	260,094,004	260,096,964	687,400	443,900	348,753	56
,340	196,613,340	o	32,763,480	81,292,894	114,056,374	41,713,960	11,230,380	29,614,626	57
,760	231,641,760	o	48,413,440	101,347,068	149,760,508	33,894,346	o	47,986,906	58
,799	123,857,148	50,828,651	30,810,736	14,086,984	44,897,720	o	78,345,426	51,442,653	59
,000	133,000,000	15,000,000	43,000,000	55,000,000	98,000,000	600,000	20,000,000	29,400,000	60
,319	169,453,319	o	18,966,738	99,333,707	118,300,445	o	14,149,618	37,003,256	61
	.....	.....	.....	.....	.....	.....	.....	.....	62
,474	103,486,480	43,500,994	31,756,193	61,296,954	93,053,147	26,173,476	6,313,455	21,442,396	63
,990	156,333,990	o	20,762,956	58,985,646	79,748,602	12,447,939	36,606,902	27,536,547	64
,090	138,592,090	o	.....	.....	.....	.....	.....	.....	65
...	.....	.....	.....	.....	.....	.....	.....	.....	66
,290	.....	.....	.....	.....	.....	.....	.....	.....	
,456	628,312,834	8,115,622	139,116,128	252,068,128	391,184,256	5,868,260	109,119,138	130,256,802	68
,867	626,463,950	6,251,917	o	149,515,447	149,515,447	o	421,461,193	61,739,227	69
,646	229,271,245	21,873,401	31,585,000	145,775,000	177,360,000	21,260,000	9,190,000	45,807,056	70
,699	289,527,135	376,564	85,214,844	143,179,804	228,394,648	355,823	15,157,318	45,995,910	71
,334	150,798,086	53,199,248	15,141,024	18,805,773	33,946,797	o	140,232,789	29,817,748	72
,600	160,624,600	o	42,246,350	75,289,782	117,536,132	o	22,191,100	20,897,368	73
,200	144,477,200	15,987,000	29,453,841	90,358,355	119,812,246	9,301,768	3,359,778	27,990,408	74
,540	128,144,100	24,537,440	9,270,631	86,487,936	95,758,567	o	27,872,800	29,050,173	75
	.....	.....	.....	.....	.....	.....	.....	.....	
,963	759,758,358	3,502,605	17,619,838	380,585,528	398,205,366	25,000,000	204,379,569	135,676,028	76
,505	456,993,605	3,103,900	14,407,115	180,966,282	195,373,397	14,042,880	187,122,610	63,558,618	77
,207	o	162,443,207	28,000,000	68,000,000	96,000,000	65,826,992	o	616,215	78
,200	182,247,990	843,210	52,135,225	75,568,797	127,704,022	34,702,660	.....	20,684,518	79
...	.....	.....	.....	.....	.....	.....	.....	.....	80
,000	71,547,000	153,906,000	24,634,846	82,448,889	107,083,735	24,634,846	82,448,889	38,059,405	81
,700	240,656,700	6,000	16,158,114	58,484,772	74,642,886	o	150,129,994	15,889,820	82
,420	211,765,420	o	35,054,564	54,888,334	89,942,898	o	31,543,277	90,279,245	83
,120	129,318,120	o	24,196,270	83,215,567	107,411,837	2,702,975	146,223	19,057,085	84
,728	55,221,297	50,179,431	33,061,312	27,354,213	60,415,525	32,369,728	14,308	12,601,167	85 86
,450	1,122,750,450	o	32,013,422	794,456,566	826,469,988	122,643,791	15,526,059	158,110,612	87
,000	621,427,000	550,000	55,432,507	418,738,811	474,171,318	52,037,474	857,450	94,910,758	88
,000	210,883,000	11,707,000	76,964,493	82,060,580	159,025,073	4,892,978	3,029,879	55,642,070	89
,874	70,780,880	74,521,994	62,239,957	47,611,669	109,851,626	o	8,178,914	27,272,334	90
,492	1,580,875,158	144,744,334	178,045,791	599,284,313	777,330,104	255,776,769	163,604,487	528,908,132	91
,120	1,464,255,747	84,640,373	98,679,400	740,420,044	839,099,444	318,130,559	21,740,900	369,925,217	92
,024	575,283,500	14,313,524	57,503,524	278,012,010	335,515,534	32,510,325	45,253,779	176,317,386	93
,440	503,292,323	74,286,117	.....	.....	.....	36,399,669	460,246,329	80,932,442	94
,706	465,403,480	55,226	42,020,476	205,765,988	247,786,464	4,615,158	129,469,200	83,587,884	95
,964	251,076,510	175,261,454	131,849,070	208,004,404	339,853,474	o	2,905,984	83,578,506	96
,900	407,226,900	6,014,000	.....	.....	209,354,661	70,346,064	58,131,132	75,409,043	97
,750	365,960,600	37,150	48,767,464	138,523,662	187,291,126	89,338,918	4,375,845	84,991,861	98
,201	126,691,871	665,330	66,223,338	39,513,607	105,736,945	o	80,414	21,539,842	99
,900	206,510,850	13,143,050	6,845,353	144,661,495	151,506,848	o	6,961,544	61,185,508	100
,800	131,266,300	21,436,500	19,025,378	99,673,520	118,698,898	o	596,930	33,406,972	101
,531	152,533,981	966,550	14,534,617	36,636,136	51,170,753	o	63,693,444	38,636,334	102
,550	114,372,800	1,058,750	47,628,800	28,602,115	76,230,915	2,818,780	6,520,645	29,861,210	103
,822	128,046,788	8,711,034	30,393,152	61,919,007	92,312,159	1,259,000	855,681	42,330,982	104
,395	93,363,865	23,312,530	17,070,392	42,447,964	59,518,356	o	26,136,680	31,021,359	105 106
,819	2,707,054,322	199,465,497	.....	.....	.....	.....	.....	.....	
,876	1,199,867,676	467,530,200	o	1,147,573,236	1,147,573,236	o	371,252,714	148,571,926	107
,507	836,626,229	252,473,278	.....	.....	1,040,000,000	49,099,507	o	.....	108
,600	129,548,600	a	o	o	o	o	117,703,821	11,844,779	109
,860	164,609,860	o	89,142,519	20,001,326	109,143,845	o	17,842,155	37,623,860	110 111
,481	960,315,120	25,361	o	1,007,669	1,007,669	829,645,392	306,620	129,380,800	112
,370	o	576,457,370	.....	.....	.....	.....	.....	.....	113
,266	449,515,391	311,875	.....	.....	.....	.....	.....	.....	114
,078	154,646,570	222,666,508	a	o	o	383,313,078	o	.....	115
,320	257,983,320	o	.....	.....	.....	.....	.....	.....	116
,039	243,208,150	904,889	o	o	o	139,474,275	o	104,638,764	117
,000	o	198,211,000	.....	.....	.....	.....	.....	.....	118
,940	163,843,440	52,500	.....	.....	.....	.....	.....	.....	119
,919	104,771,490	41,834,429	o	o	o	146,605,919	o	.....	120
,450	128,302,450	o	o	61,624	61,624	12,312,377	450,364	115,478,085	121
,791	o	122,643,791	.....	.....	.....	.....	.....	.....	122

—Includes Nevada-California Power Com-
and Desert Water, Oil and Irrigating
pany.
—Includes Ontario Power Company.
—Includes Vancouver Power Co.

z—Net output.
A—Includes 88,749,520 kw.-hr. sold to other electric railways.
B—Includes 11,744,520 kw.-hr. sold to other electric railways.

Electrical World

THE CONSOLIDATION OF ELECTRICAL WORLD, ELECTRICAL ENGINEER AND AMERICAN ELECTRICIAN

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Editor

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The Mightiest of the Mighty

THE annual statistics compiled by the ELECTRICAL WORLD on the electric light and power companies which generate in excess of one hundred million kilowatt-hours of electrical energy each year are worthy of study. Each of the companies constitutes a superpower system in itself, because one hundred million kilowatt-hours is more than many states and some nations consume, and surely, a state-wide system is a superpower system. But what shall be said of those super-super systems with outputs in excess of a thousand million kilowatt-hours yearly? Nowhere else are they to be found except on the North American continent and chiefly in the United States. Here are giant electric systems, some far-flung, others in metropolitan areas, which are the greatest in the world. And what a rebuke the bare figures administer to those who talk of giant power or of superpower as though it did not exist and was still a dream! Eleven systems generate one-third of the energy produced in the electric light and power industry of the United States—a fact of great importance. The United States Census and the McGraw directory of central light and power stations show that 6,355 operating systems were in operation in 1922, and yet 106 of them produced 80 per cent of the electricity consumed. Thus the industry of itself is working out its salvation, and the story of its accomplishment grows more interesting and marvelous with each succeeding year.

A Practical Program

THE Institute convention in St. Louis was notable for the diversity of topics treated and for the practical value of the papers and discussions. With the very large A. I. E. E. membership, it seems fitting that convention programs should give something of value to all members, and the practical features of engineering interest a large number. The midwinter convention program consisted of advanced technical papers for theoretical specialists, but the St. Louis meeting was adapted very largely to operating engineers.

Economies in electrical production, developments in motors and power systems, problems of personnel and equipment in marine work, new equipment in communication and electrical applications in mining and general industry were discussed before a large audience of Institute members. The papers were of a high grade and presented the developments made and the problems still to be solved before electricity can reach 100 per cent efficiency in application. Just as much good engineering is required in applications as in researches, and often more, for an application engineer must deal with men, money and materials in addition to technical principles.

Another feature of the meeting was the noticeable trend toward a greater participation of the Institute in national affairs. Here it can do good service by making impartial investigations and publishing the facts on many national problems having an electrical engineering background. One more point deserves comment. The policy of building up recognition for electrical men in marine work announced at the convention is a notable example of the constructive work the Institute can do.

Growing Recognition for the Rights of a Patent

IT HAS been extremely interesting to note the amount of editorial attention which has been given by the newspapers of America to the recent decision by Judge Westenhaver of the United States District Court in Cleveland in the government suit against the General Electric and Westinghouse companies charging an unlawful monopoly in the manufacture of tungsten-filament electric lamps. This quotation from the Buffalo *Courier* sounds the keynote of the general press comment:

> The game of hunting the octopi is not what it used to be. Since the days of abuses by trusts we have advanced considerably in our economic system. Government regulation has been established; the farmers have great co-operative associations; labor has big banks and is fast extending them; ownership of industry is becoming true public ownership through investment of earnings in industry's securities. Naturally public opinion in regard to business has changed. The service business performs, not its size, determines its worth.

The suit referred to was the outgrowth of the famous Lockwood investigation in New York in which the sensational charges of Samuel Untermyer naturally won wide publicity with "scare" head lines. Such an attack inevitably does harm to industry in general. It raises doubt and fear of large industrial corporations in the minds of countless people who, because they lack the facts, accept at least in part the statements of the critics and think that if the government brings suit there must surely be something very wrong.

Now comes the judge's opinion. The rights of the owner of a patent, he says, cannot be questioned. Deny him the right to license other manufacturers and appoint agents to sell and you simply compel him to keep the entire business exclusively in his own hands. Therefore, said Judge Westenhaver, in this lamp case: "The building up of a system adequate in size to market the product becomes the only ground of criticism and, in my opinion, is without merit. Such methods of doing business are in favor of freeing rather than restricting interstate trade. It appears that its system is less costly and more economical to the consumer, has improved service to the customer, and has kept prices stationary if it has not reduced them in an epoch of rapidly rising prices."

These are fundamental principles vital to every manufacturer who owns a patent, and they should be read and discussed in every household. The pity is that the

court's analysis lacks the popular appeal that wins the broader publicity for the dramatic charges of the prosecution. But in the end, as ever, "truth beareth away the victory."

Are Electrical Products to Bear the Union Label?

INCREASING concern is being expressed by manufacturers of electrical equipment at the apparent intent of organized labor to bar from union jobs material that does not bear the union label. For years panelboard and switchboard manufacturers doing a national business have been forced virtually to withdraw from the Chicago market because of discrimination there against equipment not locally made under union rules. More recently manufacturers of electric lighting fixtures have found it impossible to sell wired and assembled fixtures in Chicago, Cleveland, St. Louis and several other cities without having them stripped and rewired on the job. Now, as is told in detail elsewhere in this issue, the New York "chandelier workers" are endeavoring to establish the same restriction against fixtures not bearing the union label.

At the present time probably 98 per cent of the total production of all electrical manufacturers is under open-shop conditions. The effect, therefore, of any general interference with the sale of electrical materials and equipment which do not bear the union label would seriously concern virtually the entire manufacturing industry. An attempt to prevent the wiring of completed units of electrical equipment at the factory and demand that fixtures and laundry machinery, for example, be delivered on the job unassembled would be as impossible in point of cost and efficiency as to require automobiles to be delivered "knocked down" and assembled by a member of the machinists' local union.

But there is a principle involved that is more far-reaching than this obviously vital economic consideration. If organized labor is to refuse to install lighting fixtures that are not wired by union men, it is but a step to demand that only union-made wire be used and union-made brass tubing. From this there would be a natural progression to a demand for a union label on all sockets, switches and other wiring devices, on controllers and motors that are attached to the lines, on lamp cord, table lamps and all domestic appliances, and why not as well on meters, transformers and generators?

The electrical industry has no quarrel with the right of labor to organize and conduct its own affairs, but a letter from a labor official that has recently come to light shows plainly the direction of the wind. The issue is clear-cut: Are electrical products to be forced to bear the union label? And the answer is emphatically "No!" It is the inalienable right of every manufacturer to operate his factory as he sees fit under the common laws of the land. It is the privilege of every contractor or owner to buy and install such equipment as he desires, subject to the statutes. And it is unthinkable that the burden of added cost which such labor control of electrical products would superimpose upon the public should be endured.

Under the leadership of Charles L. Eidlitz, the Electrical Board of Trade of New York is making a fight against this attack upon the electrical industry. But there is also work to be done by the national organizations of the electrical manufacturers, jobbers, contractor-dealers and central-station companies.

Economy Limits in Generation

A NET economy of 15,000 B.t.u. per kilowatt-hour in modern American stations indicates that complete advantage has been taken of present steam and material possibilities. Until metals for operation at higher temperatures and pressures are obtained there seems little hope of increasing thermodynamic efficiency in power production to any marked degree. The designers of the new plants are vindicated in their judgment, as only three years ago the best stations operated with a net economy of only 19,000 B.t.u. per kilowatt-hour.

While this large gain in efficiency is recorded, it must not be forgotten that real economy must be determined by total cost at the switchboard or at the meter of the consumer. Along with thermodynamic efficiency gains have occurred increases in capital charges, so that fuel costs are probably 50 per cent of switchboard costs today as compared with 70 per cent a few years ago. This indicates a possibility for station designers to attack station construction costs to good advantage, and the plans for contemplated stations should be carefully weighed with this in view. One of the most promising avenues of approach lies in reducing the necessity for second and third lines of defense against equipment failures. These cost money and complicate stations even while safeguarding service, and there is thus every inducement to install the best possible primary equipment. Until fixed charges go down over-all costs will be little affected by decreases in fuel consumption.

Price, Profit and Sales Volume

CENTRAL-STATION merchandising departments and other electrical dealers continue to maintain high retail prices, and short discounts are not only making it impossible to carry on the business at a profit but are seriously retarding sales volume. The question of "spread" on electrical appliances is an old one, and for the retailer to hold out for a larger discount while the seller, whether manufacturer or jobber, sticks to his price is part of the ancient and honorable custom of barter and trade.

However, without going into a discussion of whether the retailer actually wants too great a margin or the manufacturer is taking all the profit, there is certainly a direct relation between price, profit and sales volume. It will be readily admitted that if the retail price of any article is too high in the opinion of the average ultimate purchaser, he will refuse to buy. Also, if there is no profit to the retailer, either he will discontinue an article or else will carry only a small stock to meet a small general demand, making no effort to push sales. Such conditions are against the best interests both of the manufacturer and the retailer, who need large sales volume.

There is ample evidence that lower prices on a given article or commodity have brought larger profits through greater sales. Reductions in residential rates for electricity by central-station companies over the last few years have resulted in vast numbers of new customers coming on their lines, and the industry generally has profited through increased use of energy because it has become less expensive. Had the price of electrical energy increased in the same ratio as have the prices of electrical utilization equipment, it cannot be imagined that the same rate of growth would have been attained.

Makers of electrical household appliances who are honestly desirous of gaining quantity production in their factories might profitably consider the possibilities of greater outputs. The public appreciates lower prices, and retailers of electrical appliances are much more anxious to put on aggressive sales campaigns if there is a prospect of making an actual profit.

Hydro-Electric Development of Ireland's Most Famous Stream

TO AN Irishman the Shannon is more than an ordinary stream. Immortalized in song and story, it is as dear to him as the Rhine is to the German or the Tiber was to the ancient Romans. But sentiment and charm do not suffice for even the poetic Irishman. The Irish Free State is ambitious to succeed and to realize an industrial advance which will outrival that of Ulster. Electricity offers a means to that end, and so it is proposed to dam the Shannon and refute the accusation of backwardness. When the engineeering work is done—and the development is by no means simple—the Free State will obtain 150,000,000 kw.-hr. per annum from the famous river.

This, to be sure, is not a stupendous amount of electricity, but for the present it will suffice for Ireland. Her consumption now is only 50,000,000 kw.-hr. a year, one-third of which is absorbed in Dublin. With three times that amount of energy available from hydro-electric sources, other spots in the Emerald Isle besides Dublin and Cork can be made to sparkle, and who knows but that the electricity from the Shannon may cast such a magic spell over the land as to cause her sons from near and far to return and witness a miracle second only to that performed by St. Patrick? But Ireland still has her sense of humor. She could not intrust the sacred waters of the Shannon to British engineers, but chose four German experts, only one of whom understood English, and oh! what music the rage of John Bull must be to her ears!

What 25 Watts Can Do to Net Revenue

A LAMP rated at 25 watts seems quite insignificant, but when "active" lamp wattage in a home is increased by this much the result on the net revenue is astonishing. Analyses of some of the kitchen-unit campaigns has revealed noteworthy effects from increasing the wattage in the ceiling fixture. One electric service company found that the replacement of the obsolete kitchen fixture by a modern one containing a 150-watt daylight lamp nearly quadrupled the net profit per home per year. The increase in lamp wattage in this case was about 150 per cent, or 90 watts. Results have taught this company and others that there is a large percentage of profit in any increase in consumption in a place already served by electricity at a residential rate.

The company just referred to is now actively conducting a campaign to increase by a mere 25 watts per home the lamp wattage of "active" sockets. The increase in annual consumption thus obtained may be conservatively estimated as 15 kw.-hr. (an average of two hours a day for 300 days per year). At a 10-cent rate this is $1.50 per year, and much of this is net profit. If the previous net profit per residential consumer per year was $2.50, it is seen that this active 25 watts increases the net profit about 50 per cent. Two additional 25-watt lamps in use, or an increase of 50 watts in active sockets, would virtually double the net profit. Considering that the intensities of illumination in most homes are still far below the values which are best for vision, and taking into account the unlimited esthetic possibilities of light, the increase in active lamp wattage by these small amounts should be relatively easy to accomplish. Fifty watts represents about 12 per cent of the total lamp wattage in the average home, but when it is added to consumption for two hours each night the net profit is doubled.

Air-Break Switches for Load Operations

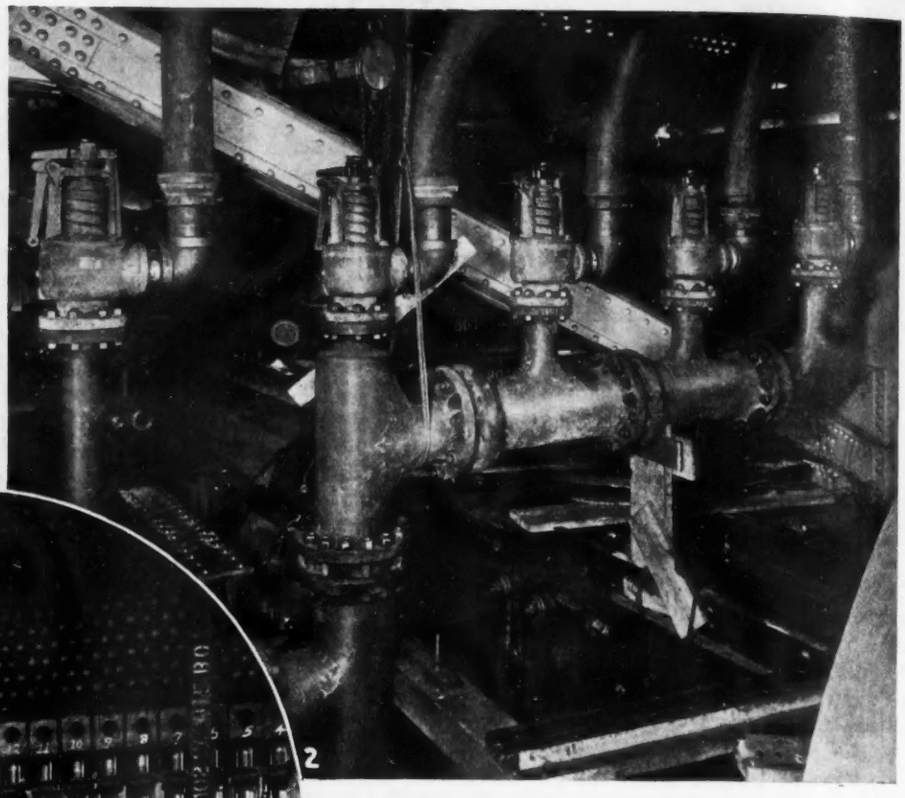
A GENERAL trend toward a greater use of air-break switches on transmission systems is noticeable. For many years a certain utility company, in tapping transmission lines, has used automatic air-break switches only and another large system has operated with fused horn gaps as the only protection against lightning. But several recent installations on other systems have been made in which fused air-break switches only are used on high-tension lines, and other high-voltage systems have used fused air-break switches to replace or supplement arresters for lightning protection. In still other cases combinations of high-tension fuses, air-break switches and oil breakers have been used to assure an improved over-all economy and protection for installations.

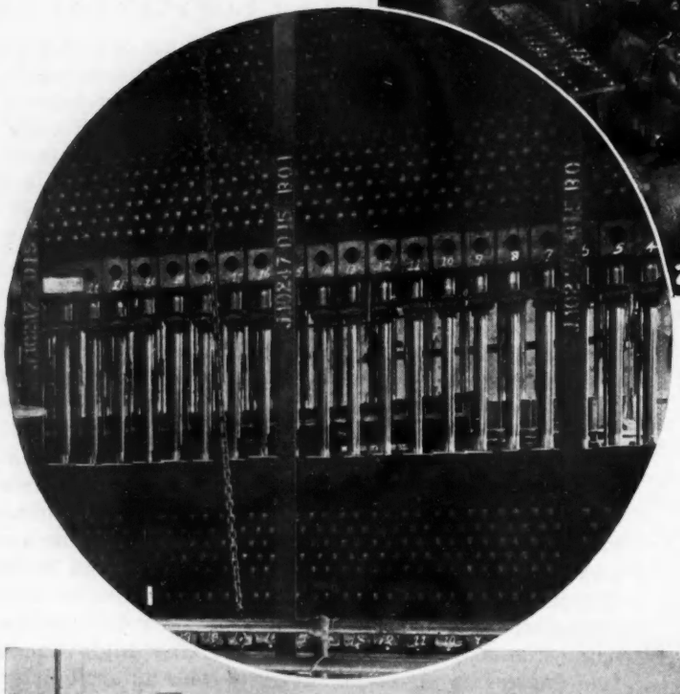
Satisfactory high-voltage fuses of a million kva. interrupting capacity have had a large part in this development, and in addition the modern air-break switch, with its contacts and insulators, has become a very satisfactory mechanical assembly. Thus it is natural for engineers to attempt to reduce switch system complexity and to increase service reliability by using the new tools. The quick-acting high-voltage fuse enables an air-break switch to clear an arc quickly and makes it a positive circuit element to supplement existing breakers.

It is the part of wisdom, however, to realize the limitations in the use of this equipment on large-capacity systems. Load switching in air is a formidable task at best and requires a degree of system protection and a mechanical spacing that reduce its usefulness to installations of limited capacity. Moreover, for interrupting service the capacity limits are very well defined, and it must be recognized that the replacement of fuses and the operation of the switches involves a degree of complexity in operation, a time delay and an operating hazard that must be carefully considered for each application. Until automatic features of operation are more fully developed, until fuse replacements can be made more rapidly and until space requirements can be reduced, it is unlikely that major trunk lines will use the new developments for load service.

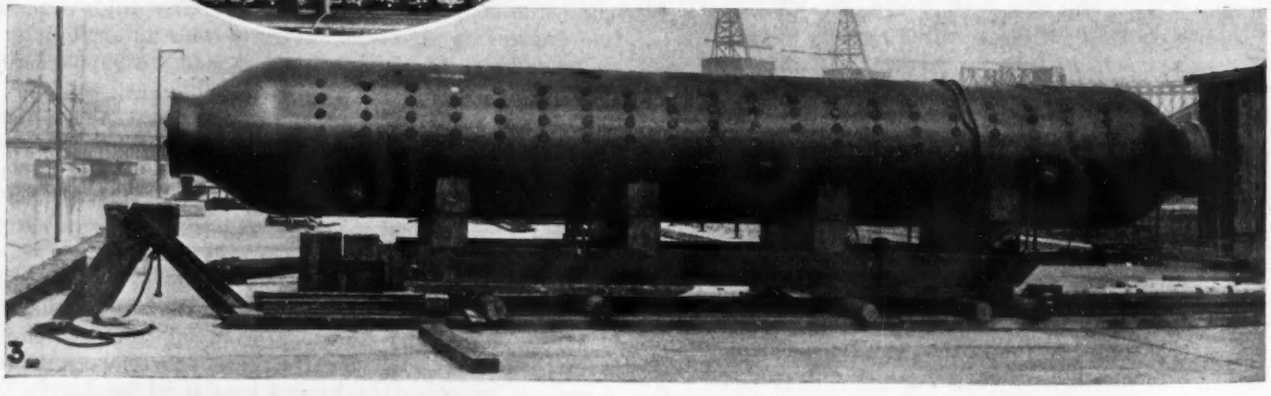
For secondary systems, for taps to serve rural communities and for giving added protection to existing installations, there is a very great field of usefulness for the air-break switch and high-tension fuse. Developments are still going on rapidly in design, and new applications appear frequently which offer possibilities for more economical construction and more reliability in operation.

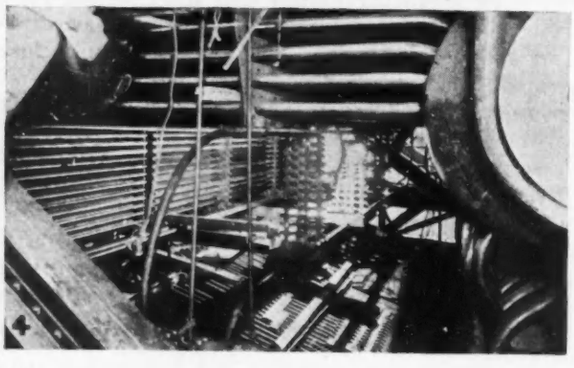
Weymouth 1,200-Lb. Boiler Interior During Construction





ENGINEERS the world over are interested in the high-pressure boiler and turbine installation at the Weymouth station of the Edison Electric Illuminating Company of Boston, now in process of construction. The accompanying views, taken expressly for the ELECTRICAL WORLD, are the first published of this B. & W. boiler during assembly. It is no mean tribute to steam boiler engineering that the usual methods of expanding tubes into headers and drum were employed in this work, and that the boiler tubing, while thicker and stronger than normal-pressure material, closely resembles the latter. The high-pressure drum is a steel forging of heavy coast artillery type.



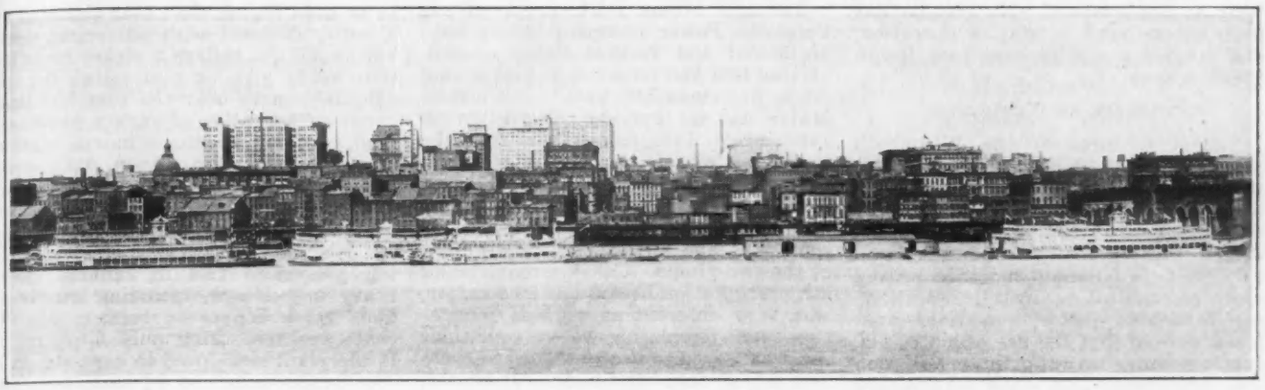


No. 1—Downtake platform showing the hand-hole side of the downtake headers and the circulating tubes connecting the upper and lower tube sections.

No. 2—Reheater safety valves from top of boiler platform. These valves protect the reheater in case high-pressure steam should enter the 375-lb. system through failure of bypass and other protective equipment to operate normally. The combined steam capacity of these valves, which discharge into the atmosphere, through roof connections, is sufficient to handle the total volume of 1,200-lb. steam taken by the high-pressure turbine at full load.

No. 3—Steam drum for 1,200-lb. boiler.

No. 4—End of high-pressure steam drum from reheater platform, showing tubes entering drum for saturated steam at 1,200 lb. per square inch. View also shows downtake headers to generating tubes. Reheater tubes and reheater drums for 375-lb. steam are shown at the left. Reheater tube baffle supports are shown in center. In this construction view the tubes in the first pass have been partly inserted, while only the "tack" tubes are in place in the second pass.



WATERFRONT AND SKYLINE OF ST. LOUIS, CHASE HOTEL, CONVENTION HEADQUARTERS, AT EXTREME LEFT

Report of A. I. E. E. Spring Convention

Diversified Technical Program at the St. Louis Meeting Proves Popular—Power Stations Now Operate on 15,000 B.t.u. per Kilowatt-Hour—Industrial Heating Featured in Several Contributions

ONE of the best discussions of power stations in recent years marked the convention of the American Institute of Electrical Engineers in St. Louis on April 13-17. Operating data on modern stations presented indicated, as recorded in the news report last week, that a fuel economy of around 14,000 to 15,000 B.t.u. per kilowatt-hour has been reached. Besides the session on power systems, there were other technical sessions on industrial, marine, mining, machine and communication topics, and these proved equally popular with the 725 visitors.

At the dinner on Thursday night former President Frank B. Jewett gave an excellent address on the present aspects of electrical communication. He sketched the great effect modern means of communication have had on the customs of mankind and discussed the status and possibilities of existing systems and methods. The telephone, he said, finds its greatest use in the realm of normal social contact and those business affairs best or most cheaply handled in this way. The telephone in America now has sixteen million instruments in seventy thousand communities, utilizing 45,000,000 miles of wire. Each year 650,000 new telephones come on the lines. The wired telephone bids fair always to retain its present supremacy, and carrier current is a limited addition to its normal facilities. The present trend is toward a greater extension of cables.

Telegraphy, Dr. Jewett said, finds its greatest field of application in the conduct of business affairs at a distance and in the transmission of impersonal intelligence. The extension of carrier current and of cables and the use of automatic equipment are outstanding tendencies in this field. The greatest achievement last year was the design of new submarine cables with a message capacity eight or ten times greater than that of older types. Radio, he thought, will be limited to broadcasting and to point-to-point communication where other means cannot be had. It will not displace other forms of communication in their existing fields.

FOLLOWING the presentation of the paper on Trenton Channel station, E. H. McFarland told of the salient features of the new Philo station of the Ohio Power Company. This plant is designed for base-load operation on a big interconnected transmission system. It operates at 550-lb. pressure at 725 deg. F. and uses a reheating process whereby steam exhausts from the turbine at 150-lb. pressure and is reheated in the boiler and used in the lower-pressure stages.

The main consideration in the design of the station was conservation of circulating-water supply, and fortunately a dam and pool were available which made it unnecessary to use circulating pumps in obtaining this supply during eight months of the year. Under-water coal storage is used, as are chain-grate stokers and ash sluicing. The coal runs about 10,700 B.t.u. per pound, and a complete feed-water treating and de-aërating plant is installed to give pure boiler water. Make-up water runs about 2 per cent, and the stack gases are around 226 deg. F.

Without reheating, the station operates on about 8 lb. of water per kilowatt-hour for a 40,000-kw. unit, and reheating improves the economy about 12½ per cent. The economy is remarkably good at all loads where reheating is used. The over-all performance of the station should improve, Mr. McFarland asserted, but existing operation at 90 per cent load factor and 33,600 kw. net output gives 14,500 B.t.u. per kilowatt-hour as the operating economy. This includes transformer losses, so that a fair value for comparative purposes is 14,200 B.t.u. per kilowatt-

Committee on Power Generation

VERN E. ALDEN, *Chairman*

"Trenton Channel Station"
C. F. HIRSHFELD
Detroit Edison Company

Data and engineering reasoning leading to the design chosen for the Trenton Channel plant. The plant will have an ultimate capacity of 300,000 kw. with 50,000-kw. units. The initial installation is for 150,000 kw.

"Features of Philo, Weymouth and Cahokia"

An informal discussion on the electrical and mechanical features on the above stations. E. H. McFarland of the Beech Bottom Power Company on the Philo station of the Ohio Power Company. I. E. Moultrop of the Edison Electric Illuminating Company of Boston on the Weymouth station. H. W. Eales of the Union Electric Light & Power Company on the Cahokia station.

hour at the busbars. No trouble has been encountered in station operation, and operating results have met design specifications.

FEATURES OF WEYMOUTH

Salient features of the Weymouth station of the Edison Electric Illuminating Company of Boston were outlined by I. E. Moultrop. Stokers were decided upon as best fitted to station design and operating conditions, and 2,300-volt auxiliary motors proved most economical to install. With 40 per cent load factor, conditions analyzed showed that the use of a 1,200-lb. supplementary steam-plant installation was less costly and more satisfactory than reheating. The high-pressure installation may or may not be used at all times, and the over-all economy with no base-load condition proved very attractive. The station is now operating with good economy, and this will be materially improved when the high-pressure unit is placed in operation.

H. W. Eales gave an illustration later on the Cahokia plant of the Union Electric Light & Power Company. The foundation difficulties were described, and it was stated that this plant without air heating and economizers gave a net performance of 16,900 B.t.u. per kilowatt-hour, with a 93,000-kw.-hr. load during January and February of this year. The circulating-water temperature under these conditions was from 32 deg. to 36 deg. F., and the coal averaged 10,700 B.t.u. per pound. President Farley Osgood opened the discussion by pointing out the necessity for engineers to give thought to the contractual and political problems associated with the present development of interstate connections. V. E. Alden, Consolidated Gas, Electric Light & Power Company of Baltimore, said that the differences in station designs were understandable if all local conditions were considered.

E. Hopping, Philadelphia Electric Company, asserted that the new Richmond station of the Philadelphia Electric Company would use stokers and single-ended Stirling boilers largely because of good and uniform quality coal, the use of air heaters and the use of economizers. Economizers are used instead of the full possibilities of air heating as there may be difficulty with the use of high-temperature air. Air at 500 deg. has been used successfully, and 650-deg. air may be tried. Single-shaft, tendem-compound, 50,000-kw., 1,800-r.p.m. units will be used in the plant, operating at about 400 lb. and 675 deg. F. The ultimate capacity will be 600,000 kw. The feed-water system is very similar to that used at Trenton Channel, and three stages of bleeding will be practiced. Two boiler-feed pumps will be used for each boiler and a steam-driven pump in addition. An emergency house turbine and bus will be available to supplement the unit auxiliary bus for each generator supplied by a transformer from the main bus. The direct-current stoker motors are operated from the emergency excitation system, and 2,400-volt alternating-current motors are used for most of the other auxiliaries. A closed ventilating system will be used on the generators.

The new Miami Fort station of the Columbia Power Company, using both horizontal and vertical firing of pulverized fuel and screen-type pulverizing mills, was described by Fred Scheffler. Major C. G. Spencer, McClellan & Junkersfeld, Inc., pointed out that the governing reasons for the difference in design between Cahokia and Trenton Channel lay in the fact that quality and cost of fuel, site conditions, location conditions and age were very different at the two plants. Cahokia required no ash precipitation because of its location, was very different as regards foundation and circulating-water conditions and was forced to use waste-heat dryers because of fuel conditions. Moreover, it was found that the single-pass condenser was better suited to deep-pit installations and the double-end type of pulverized-fuel Stirling boilers were not available three years ago.

E. H. Tenney, Union Electric Light & Power Company, observed that the use of net low-grade coal necessitated that serious consideration be given to pulverizing. The cost of preparing pulverized fuel at Cahokia from entrance to ash removal, including power for drying, was given as 33.58 cents per ton, with a total power expenditure of 25.69 kw.-hr. per ton. With 6-ton Raymond mills producing 6.85 tons per hour, 17.4 kw.-hr. per ton was required. The moisture at the entrance to dryers was 5.3 per cent, and the drying gases entered and left at 400 deg. and 165 deg. respectively. The fineness was 65 per cent through a 200-mesh screen.

A 15-ton Raymond mill producing 16.3 tons per hour used 15 kw.-hr. per ton. The coal entered with 9.8 per cent moisture and left with 4.7 per cent, with gas temperatures at inlet and outlet 465 deg. and 165 deg. respectively. The fineness was 66.75 per cent through a 200-mesh screen.

A 20-ton Fuller mill producing 23.5 tons per hour used 14.6 kw.-hr. per ton. Moisture changed in dryers from 10 per cent to 4.5 per cent and gases from 340 deg. to 150 deg. The fineness was 62.5 per cent through a 200-mesh screen. The Quigley air-transport system used 1,600 cu.ft. of air per ton of coal, and the cost of lubricating the mills was 0.6 cent per ton of coal.

H. R. Woodrow described the salient features of the Hudson Avenue station of the Brooklyn Edison Company and illustrated the use of reactors to obtain close linkage in the Brooklyn system. Experience to date showed that the system carried its load in the face of major disturbances and had proved that the fundamental desire to carry customer loads under all circumstances had been achieved. He stated that the Ward Leonard control on the direct-current motors had worked out splendidly.

TRENTON CHANNEL STATION

C. F. Hirshfeld, Detroit Edison Company, declared that old stoker-fired boilers at Detroit reached their limit between 250 and 260 per cent of rating, but with pulverized fuel the limit reached was 360 per cent of rating. The boiler offered even greater possibilities, and present limitations were fixed by the furnace and fuel-firing equipments. He said it was possible to get a stoker to give a rating as high as or even higher than that obtained at Trenton Channel with pulverized fuel, but he did not believe a stoker installation would give as high or as flat an efficiency curve over the complete load range of operation of such a non-base-load station. Trenton Channel station was designed for 16,000 B.t.u. per kilowatt-hour at 50 per cent load factor, and the performance to date indicated that that figure obtained and perhaps could be bettered. The cost of preparing pulverized fuel in January, February and March, including all items from track hopper to bunker, was 30 cents per ton, using only 6-ton mills. If the plant were used to capacity, this cost would reduce to 22 cents per ton. He emphasized the effect of local conditions on plant design, saying that Trenton Channel was not a base-load plant and that conditions at Detroit did not indicate the advisability of reactors to the extent used in Brooklyn or the introduction of de-aërators.

Other discussions emphasized the great economies obtained in the newer plants and pointed out new developments under way to change boiler and furnace design materially.

Committee on Applications to Mining Work

CARL LEE of the Peabody Coal Company said that few mine owners would invest upward of half a million dollars in a power plant for a 10 or 20 per cent return. Strikes, competition and other elements forced mine owners to reduce investments in plant to a minimum. He maintained that gathering locomotives should be rated at from 3½ miles to 5 miles per hour instead of 7 miles, as at present, as the lower speed conformed more nearly to operating conditions.

According to D. J. Shelton, the steam shovel of today has about reached its limit even when superheat or compounding is used. Any electric shovel of up-to-date model is superior to the steam shovel and has a higher bail pull and bail speed. The electric shovel by actual data will produce more tonnage. Reliability of power is the biggest item in shovel application and, provided electric power is available, the decision will always be for electric shovels. Mr. Shelton claimed that all shovels of 100 tons or more should be of the direct-current Ward Leonard type, as the alternating-current type forms a poor load for the central station and is not equal to direct current for the operations encountered.

L. W. W. Morrow of the ELECTRICAL WORLD suggested possibilities of applying the vibration indicator described by Mr. Hall to turbo-generators, transmission lines and towers and other engineering structures in order to study vibrational effects. Mr. Hall said marked progress was being made.

W. D'Arcy Ryan, General Electric Company, discussed automobile headlamps and outlined means for improving existing conditions, which he held to be very unsatisfactory from a safety standpoint. He accented the necessity of eliminating glare and outlined a specification for an ideal headlight which he thought would soon be produced.

Summary of A.I.E.E. Papers at Six Technical Sessions from Tuesday to Friday

Committee on Applications to Mining Work

F. L. STONE, *Chairman*

"Coal Mine Electrification"

W. C. ADAMS
Allen & Garcia Company

A discussion of some of the most vital problems of coal-mine electrification and descriptions of some concrete installations, including hoists, fan drive, preparation plant and converting stations.

"Application of Motors to Mine Locomotives"

W. A. CLARK
Westinghouse Electric & Manufacturing Company

An analysis of the basic design data necessary for applying electric motors to mine locomotives. The paper indicates why speed of locomotives should be considered in selecting motor horsepower.

"Electric Shovels"

D. J. SHELTON
Marion Steam Shovel Company

D. STOETZEL
General Electric Company

This paper gives information on the increasing number of electric shovels, their advantages, a general description of various types and information on different methods of control, also complete lists of electrical equipment on three shovels.

"Electric Lighting Equipment on Automobiles"

J. H. HUNT
General Motors Research Corporation

A study of the problem of head lights, particularly with reference to plans for eliminating dangerous glare. The possibility of obtaining improved results by the use of polarized light, by means of light filters and by the use of more diffused light is discussed.

"A Vibration Recorder for Pathological Analyses"

C. I. HALL
General Electric Company

The design characteristics of an instrument to be used by physicians for recording the tremors of a patient and to resolve the motions into their vertical and horizontal components. The instrument is also useful to the engineer for recording mechanical vibrations of various kinds.

Committee on Communication

O. B. BLACKWELL, *Chairman*

"Development of a New Type of Hornless Loud Speaker"

C. W. RICE AND E. W. KELLOGG
General Electric Company

Description of a series of tests directed to the evolution of a loud speaker free from resonance and the development of a practical speaker that gives an output approximately proportional to the actuating force, and independent of frequency.

"Communication in Railroad Operation"

I. C. FORSHEE
Pennsylvania Railroad System

A description of the use on railroad systems of the telegraph, telephone, telautograph, telegraph printer and radio. An ideal system provides accurate information between any two points on a railroad system or between the public and the railroad company without delay and under all operating conditions.

"Echo Suppressors for Long Telephone Circuits"

A. B. CLARK
American Telephone & Telegraph Company

R. C. MATHES
Bell Telephone Laboratories, Inc.

An account of a device for suppressing echo effects sometimes encountered in very long telephone circuits. The possibilities and limitations of the device are discussed.

"Frequency Multiplication"

N. LINDENBLAD
Radio Corporation of America

W. W. BROWN
General Electric Company

This paper presents in a condensed form physical conceptions of the operation of iron-cored frequency multipliers and some results of an investigation to determine the possibilities of increasing the usefulness of large high-frequency alternators through use of frequency multipliers.

Committee on Protective Devices

H. R. WOODROW, *Chairman*

"Use of Frequency Changers for Interconnection of Power Systems"

H. R. WOODROW
Brooklyn Edison Company

A discussion of the 35-000-kva. synchronous-synchronous frequency changer which ties together the sixty-cycle and twenty-five-cycle systems of the Brooklyn Edison Company.

"Eight Years' Experience with Protective Reactors"

JAMES LYMAN, L. L. PERRY AND A. M. ROSSMAN
Sargent & Lundy

Results of eight years' experience with reactors in three large power stations. The action of the reactors in sixteen cases of actual trouble effectually kept the power concentration within such limits that the damage was localized and no troubles were experienced from mechanical displacement of conductors and insulators elsewhere.

"Mississippi River Crossing of Crystal City Transmission Line"

H. W. EALES AND E. ETTLINGER
Union Electric Light & Power Company

Description of two long 132-kv. river-crossing spans designed for heavy ice loading. Calculations for sags and tensions used. One span is 4,279 ft., while the other is 2,681 ft.

"Automatic Control for Substation Apparatus"

W. H. MILLAN
Union Electric Light & Power Company

Suggestions for eliminating some of the troubles that may develop in the automatic operation of substation equipment are presented. It applies particularly to alternating-current distributing substations and direct-current substations feeding heavy Edison networks.

Committee on Applications to Marine Work

L. C. BROOKS, *Chairman*

"Historical Review of Electrical Applications on Shipboard"

H. L. HIBBARD AND WILLIAM HETHERINGTON, JR.
Cutler-Hammer Manufacturing Company

A review of the progress in electrical installations on vessels from the time of the first electric lighting system to the present day.

"The Electrical Engineer in the Merchant Marine"

G. A. PIERCE
William Cramp & Sons

An exposition of the responsibilities of the electrical engineer in the merchant marine and a plea for creation of an official rank for him compatible with his responsibilities and duties.

"Electrical Propulsion of Ships"

H. F. HARVEY
Newport News Shipbuilding & Dry Docks Company

W. E. THAU
Westinghouse Electric & Manufacturing Company

Study of main drive, control, auxiliaries, etc., used on various types of vessels. Special emphasis is placed on the Diesel.

Committee on Electrical Machinery

H. M. HOBART, *Chairman*

"Initial and Sustained Short Circuits in Synchronous Machines"

V. KARAPETOFF
Cornell University

Analytical and graphical treatment of general cases of armature windings displaced by arbitrary angles, with applications to one, two and three-phase machines. Formulas are deduced for both the initial and the sustained values of currents. A graphical interpretation of these equations is also given.

"Short-Circuit Currents of Synchronous Machines"

R. F. FRANKLN
General Electric Company

The application to a number of practical cases of the general formulas for short-circuit currents as given in the companion paper by V. Karapetoff.

"A Two-Speed Salient-Pole Synchronous Motor"

R. W. WIESEMAN
General Electric Company

A specially shaped pole is used to obtain two speeds at high efficiency. At either speed the motor functions exactly as the ordinary synchronous motor.

"Self-Excited Synchronous Motors"

J. K. KOSTKO
Palo Alto, Cal.

Analysis of design possibilities of the self-starting high-power-factor synchronous motor.

Committee on General Power Applications

A. E. WALLER, *Chairman*

"Load-Building Possibilities of Industrial Heating"

C. L. IPSEN
General Electric Company

A survey of the use of electric heating for steel treating, copper and brass annealing, vitreous enameling, glass annealing, baking ovens and impregnating tanks.

"A High-Frequency Induction Furnace Plant for the Manufacture of Special Alloys"

P. H. BRACE
Westinghouse Electric & Manufacturing Company

Description of production on a commercial scale of very pure special alloys by means of a high-frequency induction furnace. Complete data are given on the furnace and its operation, the high-frequency power plant and the electrolytic iron refinery used in conjunction with the furnace.

"Electrically Heated Lead, Solder and Babbitt Pots"

J. C. WOODSON
Westinghouse Electric & Manufacturing Company

Discussion of design and theory of electrically heated pots, with much detailed data valuable to both designer and user.

"Synchronous-Motor Drive for Rubber Mills"

C. W. DRAKE
Westinghouse Electric & Manufacturing Company

A study largely applying to dynamic braking of synchronous motors.

"Purchased Power as Applied to Plate Glass Manufacture"

A. L. HARRINGTON
Pittsburgh Plate Glass Company

Deals largely with the installation of electrical equipment in a large plate-glass factory. Unusual conditions in some places call for special design and construction. At present about 60 per cent of the energy used in this industry is purchased from the central station.

Committee on Communication

ANY rational basis for discussing loud speakers is lacking, in the opinion of H. A. Frederick, Western Electric Company. No basis exists for quantitative comparisons or measurements, and methods of testing are badly needed. The new loud speaker described seemed to have been designed for quality only and appeared to be very low in efficiency. C. H. Gaffney, Central Railroad of New Jersey, told how loud speakers were used for train-dispatching purposes on that railroad and had proved very satisfactory.

Worth Rogers, Missouri Pacific Railroad Company, said the railroads of the country were second or third in the use of communication facilities but had been handicapped by being in isolated units. At present there is a greater degree of engineering co-ordination and less necessity of taking communication facilities produced by other sources and then trying to adapt them to railroad needs. He maintained that loud speakers were still subject to improvement before they would be fully satisfactory for train dispatching.

P. E. Thelin of the Chicago Surface Lines said that street-railway companies needed some means of communication for use with repair and maintenance crews on large systems.

Discussion of the echo suppressor emphasized the fact that it must not interfere with the operation of the normal system. Speakers pointed out the refinements in relay engineering necessary to get the time delays, the speeds, the sensitivity and the control necessary when only voice currents were available as impulse and energy sources.

Committee on Protective Devices

SOME late tests on the frequency changer described in the paper by H. R. Woodrow showed that a full short circuit on the 25-cycle end of the changer caused no trouble on the 60-cycle voltage and did not pull out the two systems. A great amount of discussion took place on reactors and bus short circuits, and James Lyman showed the great advance toward an immense power system for supplying all industrial and railroad loads calling for absolute control of conditions. Base-load stations must be kept operating at the most economical loads, and the judicious use of synchronous condensers made it possible to control load division. Windsor plant operates with a daily load factor as high as 93 per cent, a monthly of 87 per cent and an annual of 60 per cent with a capacity factor of 65 per cent.

H. W. Eales remarked that the large station made it difficult to detect short circuits. He said a ground indicating and relay system was being installed at Cahokia in order to remedy this condition.

E. C. Stone, Duquesne Light Company, stated that his company had lately found little trouble with reactors on feeders, but that the use of bus reactors was not satisfactory unless they limited trouble and still enabled the station to give service and carry the system load. He also pointed to the necessity of ruggedness and reliability in automatic equipment and condemned price buying of this class of equipment.

H. R. Summerhayes, General Electric Company, observed that if bus sections can be isolated instantly when trouble starts on the bus the effect of short circuits could be minimized. He also said that the adoption of differential balanced and ground protection schemes were very effective in bringing this about. There were possibilities for some type of saturated-core reactor for limiting trouble conditions without interfering with normal energy transfers. Bus reactors affect both voltage and phase relations between adjacent bus sections, Mr. Summerhayes said, and this must be considered at the substations supplied by parallel feeders from different bus sections.

Committee on Applications to Marine Work

ONLY licensed electrical men should receive recognition in the merchant marine, A. B. Homer declared. A training and educational program should also be instituted if a competent electrical personnel is to be developed. A. A. Coyle said that Diesel-engine electric drives offered great advantages for river boats as well as for oceangoing vessels. He discussed existing drives for stern-wheel river boats and described new developments. L. R. Beekman, General Electric Company, pointed out that the great developments in electric equipment on land had appreciably influenced electrical naval programs.

V. Karapetoff stated that the Diesel engine when first proposed was condemned as impracticable by all authorities and showed how the Diesel electric drive of today gave a torque-control unit system of great value in all marine service. C. H. Giroux said the Diesel electric drive with Ward Leonard control applied to towboats increased the stand-still towing effort 160 per cent, and when towing four barges this system gave a towing speed amounting to 110 per cent of the direct-drive tow. He asserted that new boats would have automatic control from the pilot house. C. Huey of the United States Navy, stationed at Brooklyn, said that changes in standard voltages by marine authorities had been a serious handicap and that it had taken manufacturers no little time to design equipment suited to marine conditions. Farley Osgood indicated the necessity for bringing about a higher standing for electrical engineers on shipboard and urged the committee to work on a national plan to improve their status.

Committee on Electrical Machinery

VECTOR mathematics was advocated by Prof. Vladimir Karapetoff in preference to other mathematical tools used in machine studies, and he emphasized the importance of using the best tool and most general method of attack for initiating machine studies. H. Weichsel, Wagner Electric Company, discussed different methods used in the study of alternating-current motors and indicated the necessity of taking the more refined circle diagram into consideration when studying special types requiring refinements in analysis.

R. W. Wieseman asserted that experimental checks on several machines showed that the assumptions used in the derivation of the formula in the Franklin paper were warranted. The effect of pole-face windings was greatest as they minimized field-current fluctuations.

Val A. Fynn thought that the term "excitation" should be used with caution in connection with alternating-current commutator machines since it depended on design and operating conditions whether any winding was magnetizing, working or a combination. He showed that a large variety of machines could be produced in this field, but said that his complete investigation of the design and commercial possibilities of the self-excited synchronous induction type of machine had failed to show possibilities for the production of a general-purpose motor. This type of machine was best suited for synchronous-condenser applications as they had pick-up, power-factor-correcting ability and good synchronizing torque. They were insensitive to line disturbances and were superior to the ordinary synchronous condenser in giving a less rigid load on a power system. It may be possible to use larger sizes of the machine when separately excited for load use, Mr. Fynn said, but in general the final answer to the quest for a general-purpose alternating-current motor is the induction motor.

Committee on General Power Applications

SYNCHRONOUS motors, magnetic clutches and dynamic breaking have greatly improved operating and have enhanced safety in the rubber industry, according to S. H. Mortensen, Allis-Chalmers Manufacturing Company. A 500-hp. motor when running idle can be stopped in two revolutions and when loaded in one and eight-tenths revolutions. These same principles are now being used in steel and other industries. Other speakers accented the necessity for safety in rubber-mill operations and indicated the difficulties encountered in getting old mills to use modern equipments.

E. E. Shaw said resistance-type furnace elements became poor mechanically at 2,000 deg. F. but that a new non-metallic alloy called "glow-bar" had been used recently in a furnace at 2,500 deg. F. for treating steel forgings.

R. C. Gosreau said the power companies, the metallurgists and the electrical manufacturers had joined together to build up the electrometallurgical applications and that many new ones would surely be found in the future.

J. C. Woodson pointed out that 6-ton lead pots for 1,540 deg. F. had been built and that fourteen of these were used by one company in the tempering of axe edges.

L. W. W. Morrow stated that recent improvements in refractories removed one of the greatest handicaps to the use of high temperature electric furnaces and cited an induction type brass furnace which had operated for 400 heats without repair.

Continuous Utility Advertising

Newspaper Advertisements, Consumers' Pamphlet, Lecture Bureau, Public Inspection Trips, Educational Films, Service Manual and Posters All Used to Good Advantage

By J. CHARLES JORDAN
Manager Publicity Department Pacific Gas & Electric Company, San Francisco

SYSTEMATIC, continuous advertising conducted by the Pacific Gas & Electric Company in 1924 was so productive of results in building favorable public opinion through pleased and satisfied customers and increasing sales of service that an even more comprehensive program has been planned for 1925. In laying out and carrying through a definite schedule of sales and institutional advertising the company followed out a fixed policy of utilizing what appeared to be, after careful investigation, the most practicable mediums for improving public relations.

The first problem in drawing up the advertising program was to select a type or class of medium through which the company's message could best be brought before the greatest number of people. It was necessary to quicken public interest to a realization of the service performed, to emphasize its importance and to impress the reading public with the vital part played by the utility in development of the state and its industries.

An analysis of circulation indicated that the field could best be covered through the medium of the daily and weekly newspapers of general circulation, supplemented with community or district newspapers in the metropolitan areas. It was found that the combined circulation of those papers was in excess of the total population. It was further found that the average was better than one daily paper for each home in the territory supplied. So, with this outlet available, all of these publications, comprising sixty daily, 157 weekly, three foreign-language and twelve miscellaneous journals, or a total of 232 publications, were selected for display advertising. The space to be used totaled 236,000 column-inches, and the circulation was approximately 1,750,000, or better than one copy for each person in the territory served.

KIND OF PUBLICITY USED

Advertisements were divided into two classes—institutional and sales, the sales copy being further divided into gas and electric copy. All of the papers, daily and weekly, carried both institutional and sales advertisements, this making one advertisement a week in the weekly papers and two a week in the daily papers, the electrical alternating with the gas. The 1925 program calls for three advertisements per week in the metropolitan daily papers, making one institutional, one gas and one electrical advertisement each week. The appropriation was spread on a prorated weekly basis covering the entire year. Class, trade and farm publications were listed to tie in with special campaign or sales effort. As an example, in an electric truck campaign the bakers' magazine was used to reach that class of "prospect."

For the newspaper campaign 130 institutional, sixty-two electric sales and fifty gas sales, or a total of 242 different pieces of copy, were prepared. In the publishing of copy 11,252 Pacific Gas & Electric Company advertisements appeared in the territory served.

Supplementing the display advertising and in an endeavor to keep the public fully informed of developments, a news service was maintained, furnishing the press with 620 stories of localized or general news value. From these, 3,759 items were printed, occupying 40,254 column-inches of space, this being about the equivalent of one full page of publicity per day. All the advertisements and publicity are written and prepared within the company, a force being maintained to carry on this work as a part of the organization.

The company's house organ, *Pacific Service*, edited and published by its own force and having a circulation of 26,000 copies, keeps the stockholders and employees, as well as bankers and brokers, interested in its securities, informed of the construction activities, of the company's finances and of general developments in the territory served.

PUBLIC INSPECTION OF PLANTS

To give the members of the press first-hand information on the company's major developments, an excursion to one of the big projects is made each year, to which the editor or publisher of each paper is invited. Groups of prominent citizens, boards of trustees, supervisors, etc., are also taken to view the work going on. This phase of activity is to be extended to cover localized trips for the members of the press and others to nearby plants, substations, etc.

The *P. G. and E. Progress*, another company publication, was started at the beginning of the year and has been issued each month. This was established primarily as a journal of facts and is pledged to be an authoritative source of information for the public. Copies are mailed regularly to each customer taking service. It is an eight-page publication, letter-size, made up in newspaper style with illustrations and cartoons. It now has a circulation of 470,000 copies monthly.

To gain a closer relationship with the public, a lecture bureau is maintained. Special assignments are made from the company's forces where a particular subject is to be discussed. For lodges, luncheon clubs and similar meetings the regular lecturer presents a talk on "Hydro-Electric Development of Northern California." During the year he appeared before 215 organizations and talked to 42,513 people. He also appeared with displays and talks before country fairs, industrial expositions and at the State Fair. From within the company's force suitable entertainment is provided where necessary to complete a program. The lectures are accompanied with slides and motion pictures.

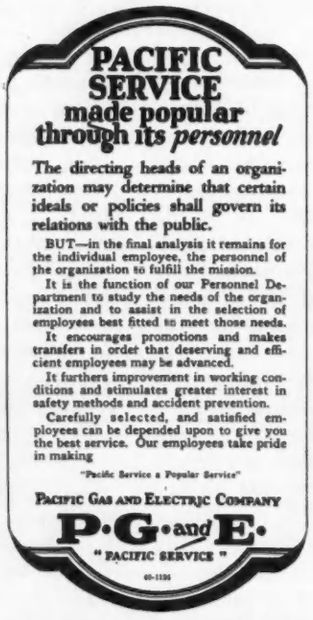
As part of the educational program, a film release, having about 10 films available, was maintained. Films

were shown before 135 organizations, attended by 20,107 people. Throughout the territory, which is divided into twelve geographic areas or divisions, the company has located motion picture and slide machines and men trained to operate them who are available if needed.

To reach the pedestrian, and tying in with the general advertising program, a display poster plant has been installed. Standard poster frames are placed in all division, district and agency offices. These frames are so constructed as to permit an interchange of posters, which are displayed in 150 different locations. Posters are changed twice a month.

Being a utility that does not sell appliances, the company turns its windows over to the local dealers, who take turns in displaying their wares.

Real Lighting
Comfort
Right now, when your living room becomes the center of home and social life, give thought to its lighting.
Most living rooms suffer in appearance and comfort from the lighting arrangements. Glare in some spots, black shadows in others, distort the furnishings and hurt the eye. Chairs must be moved to the center of the room, reading, sewing, or card playing is accompanied by a feeling of discomfort.
These are the faults of poor lighting. In the modern living room, the primary lighting arrangements—a ceiling fixture and side wall brackets—are supplemented by the generous use of floor, table, desk, and bridge lamps.
For proper lighting—see your electrical dealer or the
PACIFIC GAS AND ELECTRIC COMPANY
P·G·and E·
"PACIFIC SERVICE"


PACIFIC SERVICE
made popular through its personnel
The directing heads of an organization may determine that certain ideals or policies shall govern its relations with the public.
BUT—in the final analysis it remains for the individual employee, the personnel of the organization to fulfill the mission.
It is the function of our Personnel Department to study the needs of the organization and to assist in the selection of employees best fitted to meet those needs.
It encourages promotions and makes transfers in order that deserving and efficient employees may be advanced.
It furthers improvement in working conditions and stimulates greater interest in safety methods and accident prevention.
Carefully selected, and satisfied employees can be depended upon to give you the best service. Our employees take pride in making
"Pacific Service a Popular Service"
PACIFIC GAS AND ELECTRIC COMPANY
P·G·and E·
"PACIFIC SERVICE"

To Entertain Charmingly
—Use Electric Appliances
WHAT a real pleasure it is to entertain when smart Electric Appliances can be used for preparing dainty dishes on the tea wagon or living room table.
Attractive, serviceable Electric Appliances, such as Percolators, Grills, Toasters, Waffle Irons, etc., can be used in any room in the house where there is a handy convenience outlet. The hostess can serve tasty spreads without having to leave her guests for a half-hour's work alone in the kitchen.
Electric Appliances are convenient in many ways. Ask your dealer for information.
PACIFIC GAS AND ELECTRIC COMPANY
P·G·and E·
"PACIFIC SERVICE"

Special displays are made up, and the department co-operates with the banks by placing these in its windows. Concerning one recent display an article was written and syndicated to 119 newspapers.

To protect the public and men working in the streets a standard trench barrier has been adopted on which is printed: "A Sign of Progress—P. G. and E." Regarding the barrier, of which there are hundreds in use on the system, one of the daily papers published the following:

BLOCKING THE STREETS AND MAKING THEM LIKE IT

Our hats are off to the Public be pleased genius of a well-known power company, which found a variation for the time-honored "Danger—Men at Work" sign that from time immemorial has protected underground workmen and aroused the irate motorist, who finds his way blocked, to even greater heights of ire. Who could be angry at "A Sign of Progress"?

It is particularly desirable that the company know its position and the industry's position at all times, especially as relates to newspaper or press comment. To keep fully advised, a press clipping bureau is maintained, its duty being to clip, measure, classify and record all items relating to the company or the industry. In the territory served there were 36,764 items published relating to the company or the industry during the year, and virtually all of these the company was pleased to record as of a favorable character.

As an aid to customers and as a guide to Pacific service the company put into circulation during the year a "Service Manual." This is a twenty-four-page booklet, illustrated, and calculated to aid

FOUR EXAMPLES OF COPY USED IN THE PACIFIC GAS & ELECTRIC ADVERTISING PROGRAM

How many People do your windows Stop?
Check off a hundred people as they pass your store windows. Count the number that stop to look.
Recent tests prove that better lighting increases the number of "window shoppers" from 20% to 80%.
People always prefer to shop in bright, attractive, cheerful places.
Better store lighting always improves business. It shows the goods at their best; it facilitates selection and pleases customers.
Ask your electrical dealer or at the P. G. and E. office for facts, figures and expert advice. Let trained P. G. and E. lighting specialists serve you.
PACIFIC GAS AND ELECTRIC COMPANY
Electrify Now
Have you an electric sign advertising customers? Ask us about them.
P·G·and E·
"PACIFIC SERVICE"

the company's customers in getting the full benefits to be derived from the service rendered.

A large relief map of California depicting the location of various towns, power houses and transmission lines, indicated by miniature electric globes of various colors working on a flasher and appearing in the order of their construction, is displayed in rotation, in stores, hotel lobbies, fairs, conventions, etc. A legend on one side tells the story, eliminating the necessity for the services of a lecturer.

The year 1924 has been one during which the Pacific Gas & Electric Company's advertising and publicity program has been further unified and standardized. For 1925 a more extensive and even broader scope of continuous advertising activity is proposed and will be carried out.

Binaural Broadcasting

This Method Gives Impression of Location as Well as Impressions Concerning Character of Sound and Its Comparative Loudness — Uses Two Channels and Two Wave Lengths—Discussion of the Binaural Effect

By F. M. DOOLITTLE
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THE purpose of this paper is to describe a new method of broadcasting radio programs which gives a much more realistic reproduction than is obtainable with the method now in use. Considering the fidelity with which the present broadcasting apparatus transmits the frequencies employed in music, it may not appear reasonable to expect that any marked improvement is either necessary or possible. Certain factors besides tone values must, however, be taken into consideration. The phonograph and the radio loud speaker have educated the ear to believe that a close approximation to true tone values is really all that can be expected, and hence the listener does not expect an exact reproduction. Reproduction, using the word in its strict sense, would, of course, mean a rendition so nearly identical with the original that one would be unable to tell, without bringing into play other faculties than that of hearing, whether or not he is present at and listening to the original performance. A close approximation to such reproduction is possible with the method here to be described.

In order to understand better the details of the method employed it is desirable to analyze briefly the various impressions which are involved in the functioning of the sense of hearing and to discover just wherein lies the difference between the original and the reproduced versions of a broadcast program as now transmitted. It will be conceded that the listener to the reproduction does not receive a rendition which is sufficiently like the original to deceive him into believing that he is actually at the scene of the original performance. His failure to do this cannot be attributed alone to the slight differences between the values of the various tones in the original and reproduced versions of the performance, if the transmission is of a high order of excellence, but is due rather to the failure of the reproduced version of the performance to produce certain other impressions which are brought into existence by the original. Three separate impressions are produced whenever a sound is heard—first, there is an impression as to the character of the sound, such as simple, complex, musical; second, an impression as to its loudness; third, an impression as to the source of its origin with respect to the listener, which for brevity may be called the location impression.

Broadcasting transmitters are capable of transmitting the first impression with a high order of fidelity; the volume of sound can be readily adjusted by variable amplification, but the location impression is lacking. A listener at a broadcasting studio where an orchestra was performing would have a fairly accurate idea of the position of the different instruments even though his eyes were closed, but if he should listen to the radio reproduction of the same performance with either a headset or a loudspeaker, he would not receive any impression whatever as to their relative location. If a headset is used, the sound will appear to originate in the receivers; if a loud speaker is used, it will originate in the horn. Not only, then, is the original impression of the location of the instruments lacking, but a new impression of location is superposed upon the rendition which has no relation to the original position of the instruments in the orchestra. The listener to the reproduction receives at best an acoustically flat sound picture; the listener in the studio listens

TRANSMITTER FOR BINAURAL BROADCASTING EXPERIMENTS

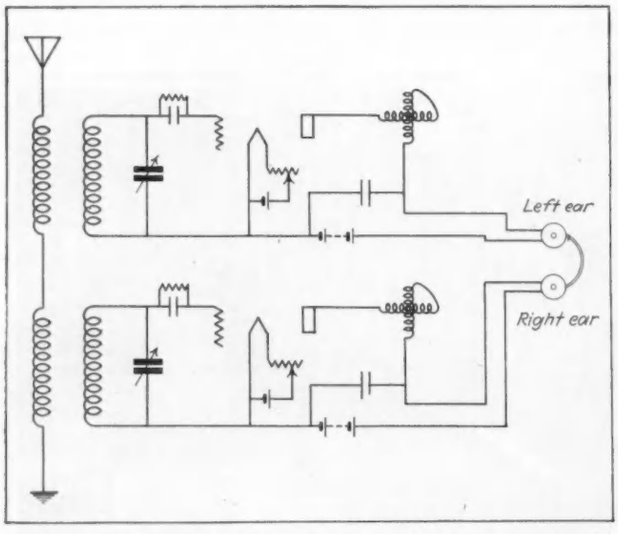
in three dimensions and is able to locate in his mind's eye each source of sound. The ensemble effect of the sounds directly transmitted from the various instruments and the sounds reflected from various points about the room tells him that he is present in person at the performance.

In the radio transmission the elimination of the location impression results in a lack of naturalness which cannot be accounted for by tone imperfection. The radio listener's acoustic relation is different from that of the listener at the performance and his enjoyment is considerably impaired thereby. Consciousness of living in three dimensions, in no small measure, may be attributed to the faculty of hearing which enables us to fix in our mind the location of the various sounds which we hear.

This faculty of space consciousness depends upon the simultaneous functioning of both ears, in much the same way that appreciation of distance depends upon the simultaneous functioning of both eyes. Advantage is taken of the latter fact in the stereoscope, an optical instrument which gives the appearance of solidity when properly photographed flat pictures are viewed through it. This instrument simulates the conditions of normal vision by presenting two slightly displaced

photographs to the eye and by providing a shield so that each eye sees only the picture intended for it. By this means and by an appropriate lens system the light which the photographs reflect is made to enter the eye in the same angular relation as though it had been reflected from solid objects, and hence the impression of solidity is created. That a similar acoustical effect could be produced, although not generally known, has been realized by several investigators and application has been made of it in a number of instances, notably in apparatus for determining the location of submarines during the late war.

In binaural listening the ears receive a slightly different sound picture, and this difference is interpreted by the mind to mean certain things with respect to the source of origin of the sounds. The difference in the sound pictures is largely a matter of the phase relation of the sounds arriving at the two ears. When several sound sources are involved, a number of different phase relations may be involved which are translated by the brain into as many separate impressions of origin. The ears possess a capacity for abstracting information from the waves presented to them which is quite as remarkable as the similar capacity of the eye.



A 100-WATT BINAURAL STATION INSTALLED IN NEW HAVEN

The impression of location is not greatly affected by the relative intensity of the sound reaching the two ears, but is almost entirely dependent upon the difference in time of arrival of the sound at the two ears. The accuracy with which the source of origin can be told is reduced if considerable difference exists in the intensity of the sound reaching the two ears, but difference in intensity does not give a new impression of location.

The broadcasting method which has been developed by the writer permits the normal functioning of the sense of hearing in the binaural manner so that the impression of space consciousness is retained. This is accomplished by providing two suitably mounted microphones at the transmitting station instead of one as now employed, so that the phase relations of the sounds produced as well as their relative intensity and tone values may be registered. These microphones are arranged to produce modulation on two non-interfering radio channels, and receiving equipment is provided so that the modulation produced in one channel may be listened to with one ear and that produced in the other channel with the other ear. By this means the ears of the listener are in effect transferred to the location of the microphones, and nearly the same sound impression is produced as though he were located in the studio. Distortion in the transmission may reduce the realism of the effect, but in the main all of the impressions which one would obtain in the studio can be reproduced.

EXPERIMENTAL STATION INSTALLED

An experimental broadcasting station, WPAJ, operating on the binaural principle has been installed at New Haven. As this station is employed in regular broadcasting service on 268 m., an additional wave length assignment of 227 m. was secured in order that binaural transmission might be made possible. Duplicate transmitters were installed. Two standard broadcasting microphones are used with a separation of about 7 in. between centers. One of these modulates the 268-m. channel and the other the 227-m. channel. The transmission of the station is not impaired for ordinary reception since the same program will be heard coming in on either wave length, but if binaural receiving equipment is installed, a naturalness in reproduction which is startling is obtained. It is essential, to obtain the best results, that headphones be used for reception, for if loud speakers are employed the sound which is intended for one ear reaches both ears and the effect is impaired, though still present in some measure. Although no publicity has been given yet to the binaural broadcasting project, a number of experimenters have been told how to install equipment for binaural reception. Without exception they have been enthusiastic in their acceptance of the new method.

In obtaining separate channels for right and left ears, use has been made of a separate wave length for each ear. There are other methods which it would be possible to use, for example, the double modulation of the carrier at two superaudible frequencies with audio-frequency variations applied to the modulation frequencies. This method would have the advantage that but one wave band would be necessary in the broadcasting spectrum, although, on account of the considerable difference in side-band and carrier frequencies, greater width than usual would be required. With such a scheme one tuning adjustment would suffice for tuning in various stations, since all stations could be operated with the same carrier frequencies and the carriers could be demodulated with circuits of fixed constants. Changes in intensity due to fading would be uniform on both channels, which might very easily not be the case with the double-wave-length method of transmission.

For immediate adoption this scheme is not, however, particularly adapted, since the ordinary type of receiver would receive inarticulate sounds. Such a condition would be very undesirable, particularly if high power were used in the transmission. For the present, therefore, a method is being employed which does not interfere with ordinary reception.

The obtaining of two independent channels with two wave lengths is easily accomplished, if reasonable separation can be made between the transmitting antennas, by the simple expedient of coupling a trap circuit tuned to the opposing wave length to each antenna. Another scheme which will work equally well or better, if space for erection of two radiating systems is not

available, consists in radiating both waves from a single antenna. The circuit employed is shown herewith. The antenna system has two points of zero reactance which are adjusted for the wave lengths employed. The right and left ear transmitters are coupled to this antenna system. A certain amount of cross-talk between the right-ear and left-ear channels exists with this scheme, but if this does not reach too high a value, the binaural effect is not impaired. A much higher percentage of cross-talk is permissible than could be allowed if independent programs were transmitted simultaneously.

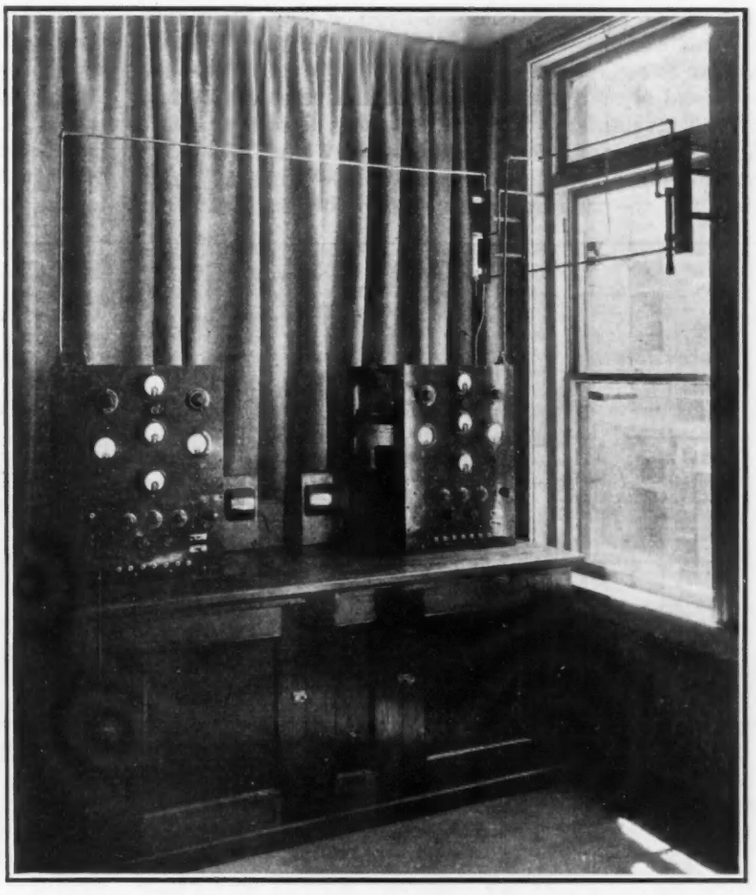
The binaural receiver can also be operated from a single antenna with any one of a large variety of circuit arrangements. A simple receiver employing two tuning adjustments and two detector bulbs is most satisfactory. When mounted in a single cabinet such a receiver is no more costly than the usual broadcasting receiver, since common batteries can be used, and as it is intended for headphone use the total number of bulbs employed need be no greater than that employed in the ordinary loud-speaker set.

A number of interesting points have been discovered in the operation of this binaural broadcasting system. If the two microphones at the transmitting station are placed 6 in. or 7 in. apart to correspond to the separation of the ears, a normal impression of the size of the studio and the location of the performers is transmitted. If the microphones are moved further apart, an impression of greater depth is obtained and the performers seem to recede to a greater distance. If the microphones are moved still further apart, the binaural impression becomes very vague and is finally lost.

Since a sound originating either in front or in the back may have the same phase relation, some factor other than phase relation must be involved in the ability to discriminate between sounds heard in front and those heard in the rear. This power of the sense of hearing is apparently a function of the outer ear, for if the passage to the eardrum is tightly closed, the power to tell whether the sound originates in front or in back is destroyed, although the power to tell from which side a sound is coming is transmitted through the skull. The outer ear with its cavities and channels is believed to produce interference effects which vary with the angle from which the sound wave arrives, so that the wave form is in some way modified before the vibrations actually reach the eardrum. In any event, by properly shielding the backs of the microphones with material which partially absorbs sound the impression can be created of the sound originating in the rear of the listener instead of in front of him.

There is considerable difficulty experienced in satisfactorily describing the binaural functioning of the ears because of the general lack of understanding of the dependence of the space-conscious sense upon the phase relation of the sounds arriving at the ears. This space-conscious sense is experienced by every one with normal hearing, but is rarely analyzed. The writer has devised, therefore, an apparatus for quickly demonstrating the principle, which is shown herewith. It consists of the usual type of medical stethoscope with

EXTERIOR OF EXPERIMENTAL BINAURAL STATION IN NEW HAVEN



POWER UNITS AT STATION WPAJ IN NEW HAVEN FOR BINAURAL BROADCASTING ON WAVES OF 268 M. AND 227 M.

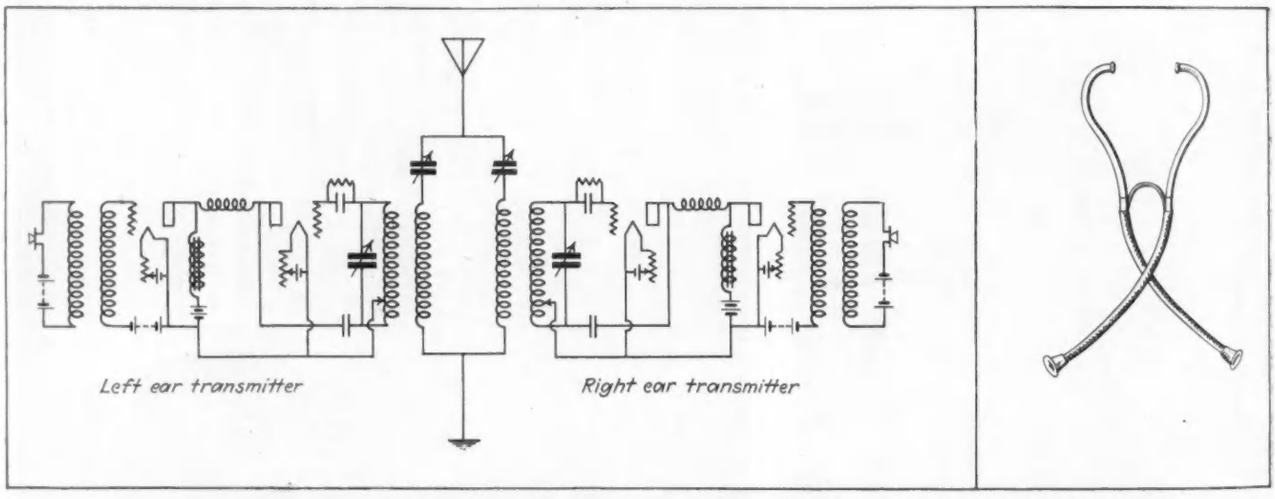
a separate sound collector connected to each listening tube by means of a flexible rubber tube. If the stethoscope tubes are placed tightly in the ears, direct entry of sound is eliminated so that the sound collectors are in effect substituted for the external ear, the sound passing through the rubber tubing and the metal tube of the stethoscope. If the sound collectors are held 6 in. or 7 in. apart, a listener is not conscious of any substantially different effect either in quality or direction of sounds originating about him, and his ear appears to function normally. If now the flexible rubber tubes are crossed so that the sound collector which is connected with the right ear is on the left and that connected to the left ear is placed on the right, the impression of the location of sound will be completely reversed. Although a listener may be looking at some one who is speaking on his right, the voice will appear to come from the left. If the listener closes his eyes and is then asked to look at the person speaking, he will involuntarily look in the wrong direction. There is no loss in naturalness or unpleasant effect produced, but merely a complete reversal of the sense of direction. In the binaural radio system this impression of the reversal of direction can be obtained by reversing the headset.

If high-quality transmitters and properly designed receiving equipment are employed, there is no substantial difference in the effect produced when listening in the studio and when listening over a radio set. Imperfections in the transmission may reduce the stereo-audic effect and static and extraneous noises may tend to reduce it further. It is of interest that since static noises are received simultaneously by both ears and do not produce the binaural effect, a new basis has been discovered for discriminating against static.

Binaural transmission also produces an apparent increase in volume. If switching arrangements are provided so that the headset may be quickly shifted from the usual or monaural reception to binaural reception, sounds which are heard will appear to jump to their respective locations in three dimensions, and simultaneously there occurs an increase in volume. This increase has not been satisfactorily explained. However, since the binaural way of listening is the normal way, it is not difficult to imagine that an interference effect of some kind is produced by subjection to abnormal phase relations.

In a complex musical performance there exist simultaneously many different phase relations which contribute to the total effect. Some of these phase relations are due to sounds transmitted directly from the instruments and some are due to virtual sources of sound caused by reflection. In the usual method of broadcasting the reflected sounds produce only an unpleasant sense of hollowness and are, therefore, minimized by installing heavy sound-absorbing hangings in the studio. The degree of damping obtained in this way is considerably greater than is desirable for the most satisfactory listening in the studio itself, and frequently the performers do not feel at ease in a broadcasting studio because of the lifeless response which they obtain from their efforts.

With the binaural method the reflected sounds produce a normal reaction, namely, to convey to the listener an impression as to the size and general surroundings of the room in which the performance is going on, and it is, therefore, unnecessary to employ as much sound damping as is customary in monaural broadcasting. It is, therefore, easier for the performers to do justice to themselves in their efforts to entertain. It has been suggested that since the binaural effect depends primarily on the phase relation of the sound waves arriving at the two ears, it might be artificially produced by introducing a slight lag in the time of arrival of the sound at one of the ears either by electrical or acoustical means, thus avoiding the necessity for duplex transmission. This unfortunately is not true, since a multiplicity of phase relations are involved and the introduction of a time lag at the receiving set produces the same phase relations in all sounds. An effect which is suggestive of the stereo-audic effect which binaural transmission produces can be obtained in this way by substituting stethoscope tubes for listening purposes and connecting them to the same telephone receiver by different lengths of rubber tubing. No power is given in this way to distinguish direction, but a mellowing of tone is obtained. Another effect which has been studied is that obtained when two properly spaced microphones are so connected as simultaneously to modulate a single radio transmitter, receiving being done by the usual monaural type of receiving set. With this arrangement "both ears hear what each ear should hear," although no power to locate the performers is obtained.

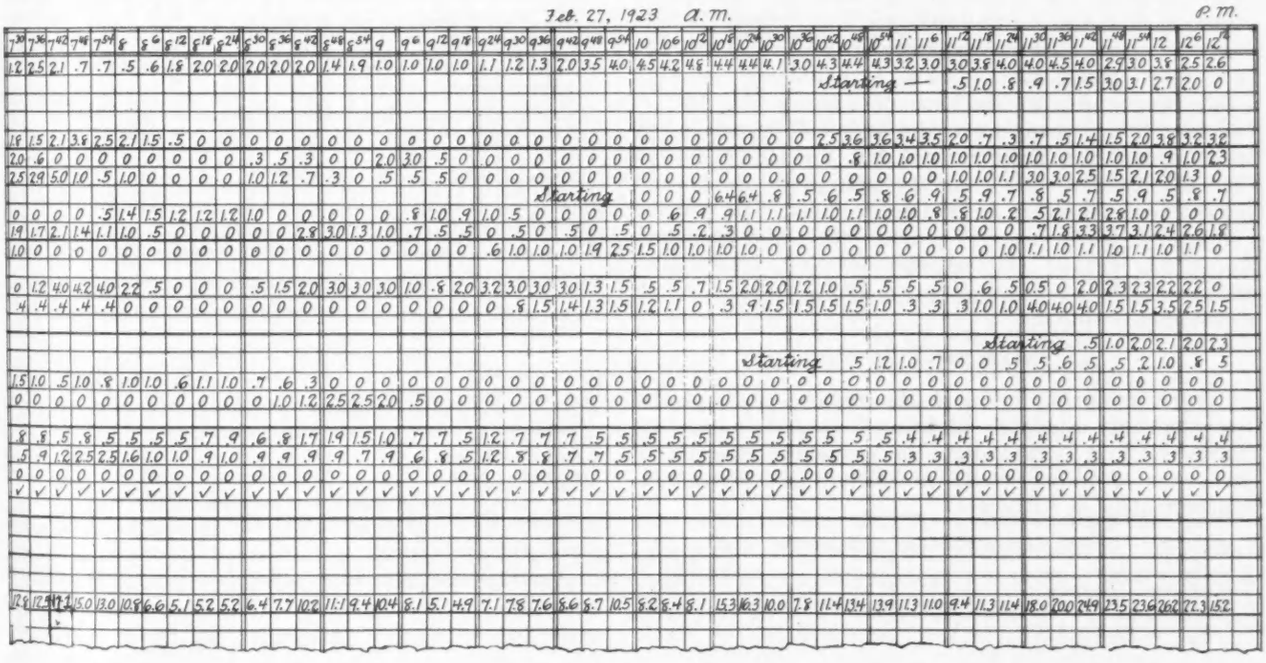


AT LEFT—A SCHEME FOR RADIATING TWO WAVES FROM A SINGLE ANTENNA. AT RIGHT—A MODIFICATION OF THE STETHOSCOPE TO GIVE SPACE CONSCIOUSNESS

Cost of Serving the Electric Range Load

Investigation of Electric Range Customers Shows Diversity Factor to Be 12.36—Average Customer Uses 271 Kw.-Hr. Monthly—Annual Gross Revenue $165 per Kilowatt of Diversified Demand

TO DETERMINE the over-all investment in system capacity, the diversity factor and what kind of a rate is necessary to serve the electric range load at a profit, the Narragansett Electric Lighting Company recently made a complete study of the cost of furnishing this class of service in Providence and surrounding towns. The method employed in making this investigation is particularly interesting, as it brought out valuable data on the characteristics of the load and a detailed analysis of investment in system capacity. As a result of its study the company has put into effect an electric cooking and heating rate that is attractive to the customer and will enable the company to serve this load at a profit irrespective of whether range customers are concentrated in localized areas or widely scattered throughout the company's territory.



DATA SHEET SHOWING INDIVIDUAL DEMANDS OF TWENTY-ONE RANGE CUSTOMERS AT SIX-MINUTE INTERVALS

The company's original cooking rate was filed in 1914 and was as follows: A monthly demand charge of $2 for installations of 5 kw. or less, $3 for installations from 5 to 7 kw., and $1 per kw. in excess of 7 plus an energy charge of 1.5 cents per kilowatt-hour. At that time there were no customers using electric cooking service and it was necessary to base the rate upon hypothetical conditions and data obtained from other companies which also had had only a limited experience with this class of business. Since that time the number of cooking customers had increased to approximately 200 in 1923, when it was felt that there was a sufficient number to obtain accurate cost data based upon local conditions. In February and March of that year the company proceeded to conduct a series of tests of actual range installations and make an analysis of the cost of service and nature of the load.

A number of graphic meters were secured to record the amount of energy used by individual cooking customers at six-minute intervals throughout the day. Twenty-one of these instruments were installed and the readings of each were consolidated so as to show the simultaneous combined load of these customers. The accompanying reproduction shows how the individual customer's use of energy was entered on a sheet and the twenty-one entries added to obtain the total kilowatt demand. From this total daily load curves of the twenty-one customers were plotted. These data were taken for a period of two weeks and representative charts showing the loads on Wednesday, Feb. 28; Friday, March 2; Saturday, March 3, and Sunday, March 11, are reproduced on page 873.

The electrical cooking and heating equipment used by the twenty-one customers consisted of twenty-one ranges having a total rating of 140 kw., six water heaters having a total rating of 17 kw., and miscellaneous heating and cooking appliances having a total rating of 41 kw., or a total rating for all apparatus of 198 kw. Two of the water heaters, each of 3 kw. capacity, were so connected through a double-throw switch that they could not be used when the ranges were in operation. This reduced the total amount of energy that could be used at any one time to 192 kw.

The consolidated load charts show that the maximum cooking load between the hours of 4 and 5 p.m. (the time of the Narragansett company's station peak) did not exceed 15.55 kw. This load occurred on Wednesday,

Feb. 28, and is shown on the chart for that day. The diversity factor at the time of the station peak would thus appear to be 12.36, which was used in the calculations for determining the amount of generating station, transmission line and substation equipment chargeable to this class of business.

The greatest load at any time occurred on Sunday, March 11, and amounted to 41.6 kw. This load was nearly equaled on Friday, March 2. Charts showing the load on those dates are among those reproduced here. The diversity factor of the greatest load occurring at any time was 4.6, and as this load undoubtedly coincided with the maximum residence load, this figure was used in calculating the cost of distribution equipment and apparatus properly chargeable to electric cooking. In both cases diversity factor was considered to be the ratio between the total rating of the installed apparatus, not including, however, water heaters controlled by double-throw switches, and the consolidated load.

In computing the cost of the local investment for each range—that is, the investment in equipment and apparatus between the street circuit and the customer's premises and also on the customer's premises—it was assumed that a 3-kw. transformer was required for each 5-kw. range and a 5-kw. transformer for each 7-kw. range. Up to the time of making this test it had been the company's practice to install 5- and 7½-kw. transformers for these ranges, but the study showed that the smaller sizes could be used with safety and the rate was therefore figured accordingly. The general investment, which includes general offices and branches, storehouse, garage, station office building, automobiles and so forth, was charged to cooking customers on a customer basis.

INVESTMENT COSTS

Consolidating the costs of the various units of the Narragansett Electric Lighting Company's system chargeable to a 7-kw. range, the prevailing size, shows that such a range would necessitate an investment approximately as follows:

Generating station, transmission system and substation	$94.77
Distribution system	136.15
Local investment, transformer, service wires, etc.	113.63
General investment	11.16
Total investment for 7-kw. range	$355.71

The same method was pursued in establishing the investment for a 5-kw. range and for each additional kilowatt over seven. Details of the calculations made in arriving at the total fixed charges, cost of distribution lines and local investment are shown in Tables I, II and III. From its study of the range load char-

TABLE I—TOTAL FIXED CHARGES ON INVESTMENT TO SERVE ELECTRIC RANGE

	Connected Load 5 Kw.	7 Kw.
Local Investment:		
Total $93.53@15 per cent	$14.03	
113.63@15 per cent		$17.04
Generating and Transmission Equipment Charge:		
Investment per kilowatt of diversified demand, $135.38@13.27 per cent, equals $17.90 income required per kilowatt of actual demand.		
Diversity factor 12.36.		
Kilowatt demand per kilowatt connected 0.081.		
Corrected for losses (14.5 per cent), 0.095, say 0.1.		
Fixed charges per kilowatt connected, $17.90 × 0.1, equals $1.79	8.95	12.53
Distribution:		
Investment per kilowatt connected $19.45.		
Fixed charges at 15 per cent equals $2.92 per kilowatt connected	14.60	20.44
Customer Cost:		
General investment	1.68	1.68
Total	$39.26	$51.69

COST PER ADDITIONAL KILOWATT OVER 7 KW.

Local investment, 15 per cent of $16.23	$2.43
Generating	1.79
Distribution	4.37
Total	$8.59

TABLE II—ESTIMATED COST OF DISTRIBUTION LINES

Estimated cost of circuit per mile, $3,760.	
Average length of 15 circuits, 98,460 ft., or 18.64 miles.	
Total cost of circuit at $3,760 per mile	$68,408.80
Cost of substation, land, equipment and buildings (total divided by number of circuits), $11,563.	
Total	$79,972.80
Deduction for poles and fixtures (46 per cent charged to distribution at $2,500 per mile) $22,554.40.	
Net cost of circuit	$57,417.40
Maximum capacity of circuit, 750 kw.	
Diversity factor, 4.62.	
Kilowatt load on lines per kilowatt installed at customer's premises, 0.217.	
Corrected for losses (14½ per cent), 0.254.	
Connected load when line is fully loaded, 750 divided by 0.254 equals 2,952 kw.	
Investment per connected kilowatt, $5,417.40 divided by 2,952 equals	$19.45.

TABLE III—LOCAL INVESTMENT TO SERVE ELECTRIC RANGE

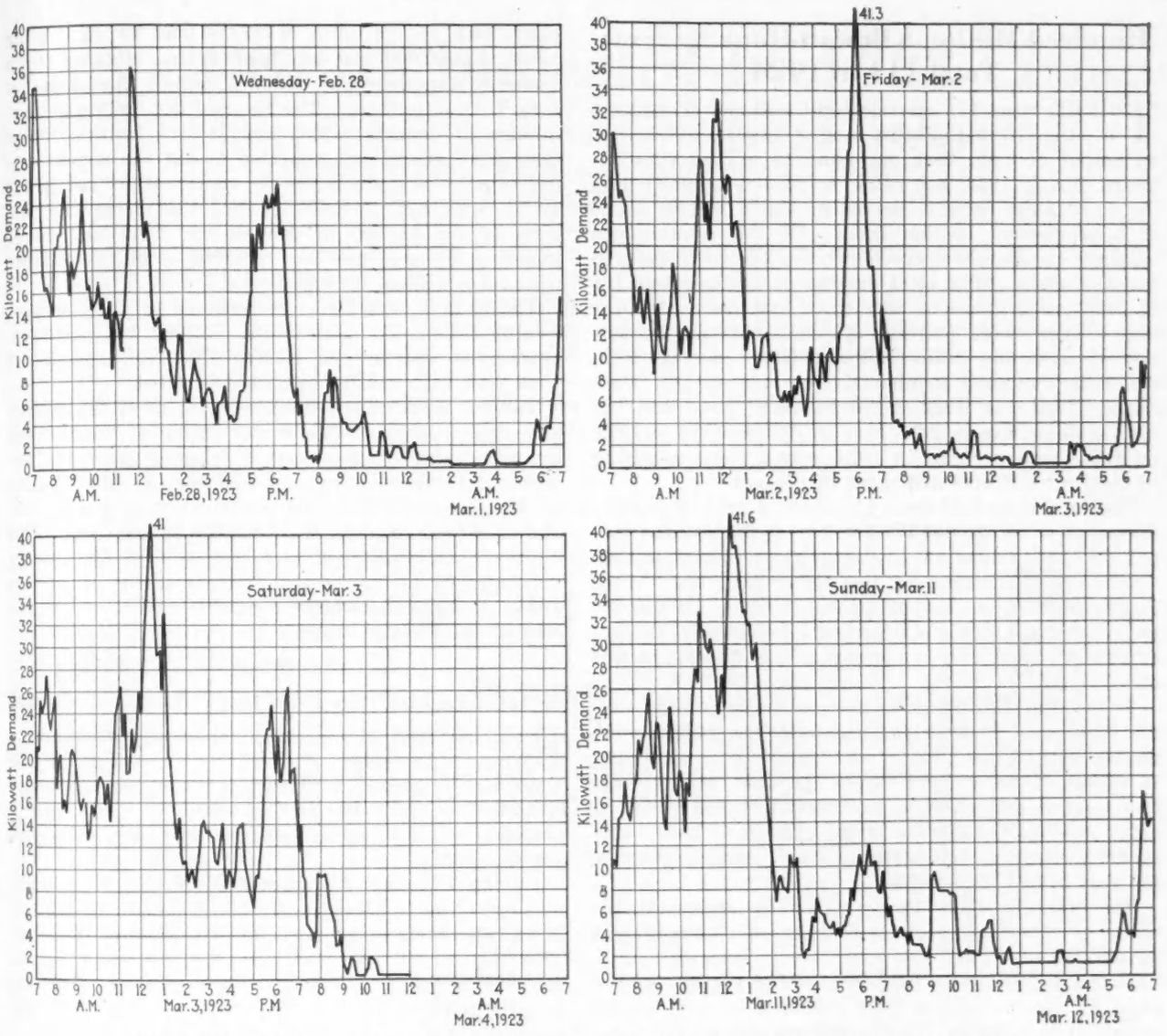
	5 Kw. Range	7 Kw Range
5-kw. transformer (3 kw. for 5-kw. range)	$48.42	$66.10
25-amp. three-wire meter (15 amp. for 5-kw. range)	10.91	13.37
Palmer box	8.25	8.25
Meter trim	2.50	2.50
Three-pin house iron	.90	.90
3 pole irons	.30	.37
Solder, paste, etc.	.43	.43
Type A boxes (2), 2 fuses, ground wire, pipe, moulding and cap: total, $11.76 (used with each transformer)	5.88	5.88
6 D.G.D.P. insulators @ $0.071	.43	.43
Miscellaneous supplies	.25	.25
Service wires, 150 ft. No. 6 3-wire	9.45	9.45
Labor and transportation	15.00	15.00
Total	$102.71	$122.81

CREDIT FOR LIGHTING SERVICE

100 ft. No. 10 R.C. wire	$1.00		
Two-pin house iron	.60		
2 pole irons	.20		
4 glass insulators	.24		
Solder, tape, etc.	.25		
Labor	1.25		
Teaming	1.25		
Palmer box	3.10		
Meter trim	1.29		
	$9.18	9.18	9.18
Net local investment		$93.53	$113.63

TABLE IV—CONNECTED LOAD, ENERGY, CONSUMPTION AND REVENUE FROM ELECTRIC COOKING AND HEATING CUSTOMERS

Year	Number of Bills	Kilowatt Demand in December	Service Charge	Kw.-Hr. Used	Amount Charged	Average Bill	Rate in Cents per Kw.-Hr. Used	Average Use Kw.-Hr.	Number of Bills in December
1914	8	18.0	$33.20	1,956	$72.32	$9.20	3.69	244	3
1915	30	$27.0	129.89	10,788	345.33	11.52	3.20	259	4
1916	65	64.0	260.80	17,944	561.36	8.62	3.13	276	10
1917	179	99.0	578.95	32,847	1,071.48	5.98	3.26	183	16
1918	319	201.0	933.56	56,347	1,779.04	5.58	3.16	177	32
1919	438	272.0	1,335.13	93,043	2,731.36	6.24	2.94	212	41
1920	643	456.0	1,999.62	157,113	4,356.96	6.77	2.77	244	72
1921	1,274	836.0	4,026.26	362,129	9,459.10	7.42	2.61	284	131
1922	1,808	1,065.0	5,999.93	521,104	13,822.97	7.65	2.66	289	169
1923	2,471	1,548.0	8,508.95	644,890	18,178.20	7.37	2.82	261	235
1924	2,990	1,742.8	14,106.05	813,453	26,313.59	8.79	3.24	271	273



CONSOLIDATED LOAD CURVES SHOWING COMBINED DEMAND OF TWENTY-ONE ELECTRIC RANGE USERS

acteristics and resultant investment costs the company found it advisable to revise its domestic heating and cooking rate, increasing the monthly demand charge on a 5-kw. range from $2 to $3.50 and on a 7-kw. range from $3 to $4.50 and reduce the charge for any excess from $1 per kilowatt to 75 cents per kilowatt. The energy charge of 1.5 cents per kilowatt-hour remained unchanged. The company's revised heating and cooking rate is given herewith, and it will be noticed that it is based on a year's use of the service, the demand charge being on an annual basis.

The Narragansett company had on its lines in December, 1924, a total of 273 electric cooking and heating customers who had a combined demand for that month of 1,742.8 kw. The average bill during 1924 was $8.79. Growth in number of range users on the company's lines during the last ten years may be traced in the accompanying tabulation, which contains very interesting data on the use of energy and revenue from this kind of business. It is interesting to compare the figures for the years 1922 and 1924. Had the revised rate been in effect for the calendar year 1922, the company's receipts for energy sold for domestic cooking and heating purposes would have been 3.2 cents, against an average of 2.66 cents, the actual amount received for that period. During the year 1924 customers used an average of 271 kw.-hr. per month, which earned a rate of 3.24 cents per kilowatt-hour.

For the twelve months of 1924 the average connected load was 1,604 kw., which, based on a diversity factor of 10 to 1 (12.36 corrected for losses of 14.5 per cent), produced an annual revenue of $165 per kilowatt of diversified demand. The average connected load per customer is 6.44 kw. and the revenue per kilowatt of total connected load is $16.50. The company therefore receives a gross annual revenue of approximately $105 per range customer including the use of the water heaters and other miscellaneous appliances.

DOMESTIC HEATING AND COOKING RATE

For electricity used for domestic cooking and heating and is not applicable to electricity used for commercial purposes.

The cost under this rate will consist of two items; first, an "Investment Charge" based upon the size of the customer's equipment and, second, an "Electricity Charge" based upon the number of kilowatt-hours used as follows:

Investment Charge

Size of Customer's Equipment	Annual Charge
5 kw. or less	$42
Over 5 kw. but nor over 7 kw.	$54
Over 7 kw.	$54 plus $9 for each kw. or fraction thereof over 7 kw.

Electricity Charge

All electricity used will be charged for at the rate of 1½ cents per kilowatt-hour.

The "Investment Charge" will be billed to the customer in equal monthly installments, provided, however, that where the service is used by customers at other than their permanent residence, the company may bill the "Investment Charge" in advance or in less than twelve monthly installments.

Hundred-Million-Kilowatt-Hour Systems Total 111 in 1924

THERE were 111 electric light and power systems in the United States and Canada which had an output of more than one hundred million kilowatt-hours during 1924, according to reports submitted to the ELECTRICAL WORLD, details of which will be found in a supplement to this issue. Of this number one hundred and six are operating in the United States and five in Canada. The total number of systems was 108 in 1923, an increase of only three systems during the year. There were fourteen systems reporting an output of over one billion kilowatt-hours during 1924, which is the same number as reported in this class during 1923. In 1922, however, there were only six such systems, five in 1921, nine in 1920 and six in 1919. Of these supersystems in 1924, eleven were operating in the United States and three in Canada.

The total output of these 111 electric light and power systems was 55,528,640,177 kw.-hr. Deducting the output of the Canadian systems gives 52,461,169,205 kw.-hr. as the output of the systems in the United States having an output of more than 100,000,000 kw.-hr. in 1924. This is a gain of 7,591,530,328 kw.-hr., or 16.8 per cent, over the output of the systems in this class in 1923.

Table I is believed to be a complete list of the electric light and power systems and electric railway companies of the United States and Canada with an output in excess of 100,000,000 kw.-hr. in 1924, giving their total output and data on peak and average load. In order to make the history of the growth of these large systems more complete, data have been included for the ten-year period 1915-1924.

The Niagara Falls Power Company again led the country, reporting a total output of 2,858,482,674 kw.-hr., all of which was generated in its own plants. This is a gain of more than 260,000,000 kw.-hr. for the year, by far the largest gain recorded by any system in the United States. The Commonwealth Edison Company was second with 2,787,090,000 kw.-hr., being about 71,000,000 kw.-hr. behind the Niagara Falls Power Company. The Edison United Companies of New York were third. The Hydro-Electric Power Commission of Ontario, which includes the Ontario Power Company's operations, reported by far the largest output of all the systems on the continent, if not in the world, with 3,026,615,156 kw.-hr., this being the first time in the history of the electric light and power industry that a system has reported an output of more than three billion kilowatt-hours.

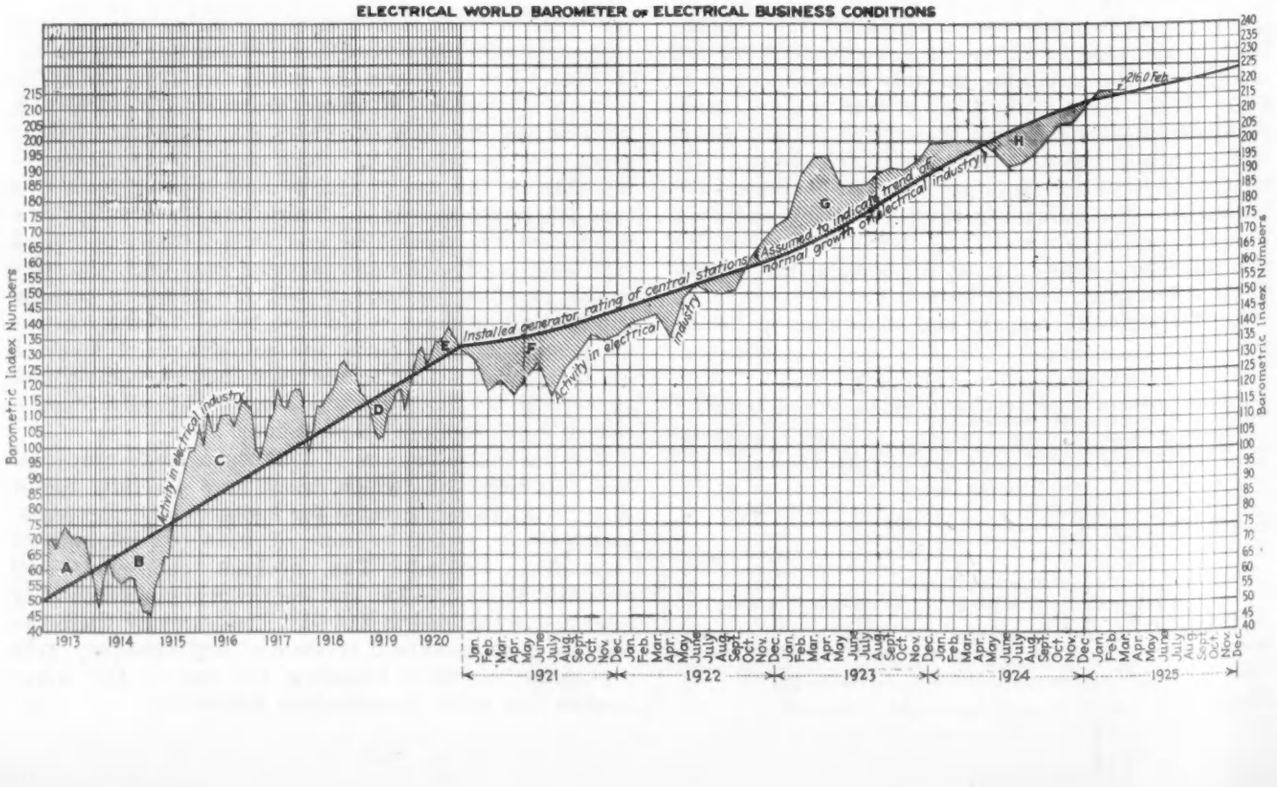
The largest peak load was reported by the Commonwealth Edison Company, with 717,000 kw., instantaneous, followed by the Edison United Companies of New York with 615,283 kw., instantaneous.

Table II lists these systems by sections of the country and gives, besides the generator rating of the systems, the proportion of the output which was generated, the amount of energy purchased and also the distribution of the energy. The 106 systems operating in the United States generated 43,070,158,113 kw.-hr. This figure is approximately 79.8 per cent of the energy generated by all the central stations of the country in 1924. In 1923 these large companies generated 83 per cent of the total production.

Activities During February Above Normal

PRODUCTION figures upon which the "ELECTRICAL WORLD Barometer of Business Conditions in the Electrical Industry" is based indicate that February witnessed a slight decrease in activity. The industry, however, was still operating above the estimated normal for the month.

During February the electrical industry as a whole was operating at 1.0 per cent above normal. In January it was operating at 1.6 per cent above and in December (revised) at 0.7 per cent below the estimated normal for the respective month. This slightly abnormal activity reflects the continued large volume of general trade as evidenced by the record freight car loadings.



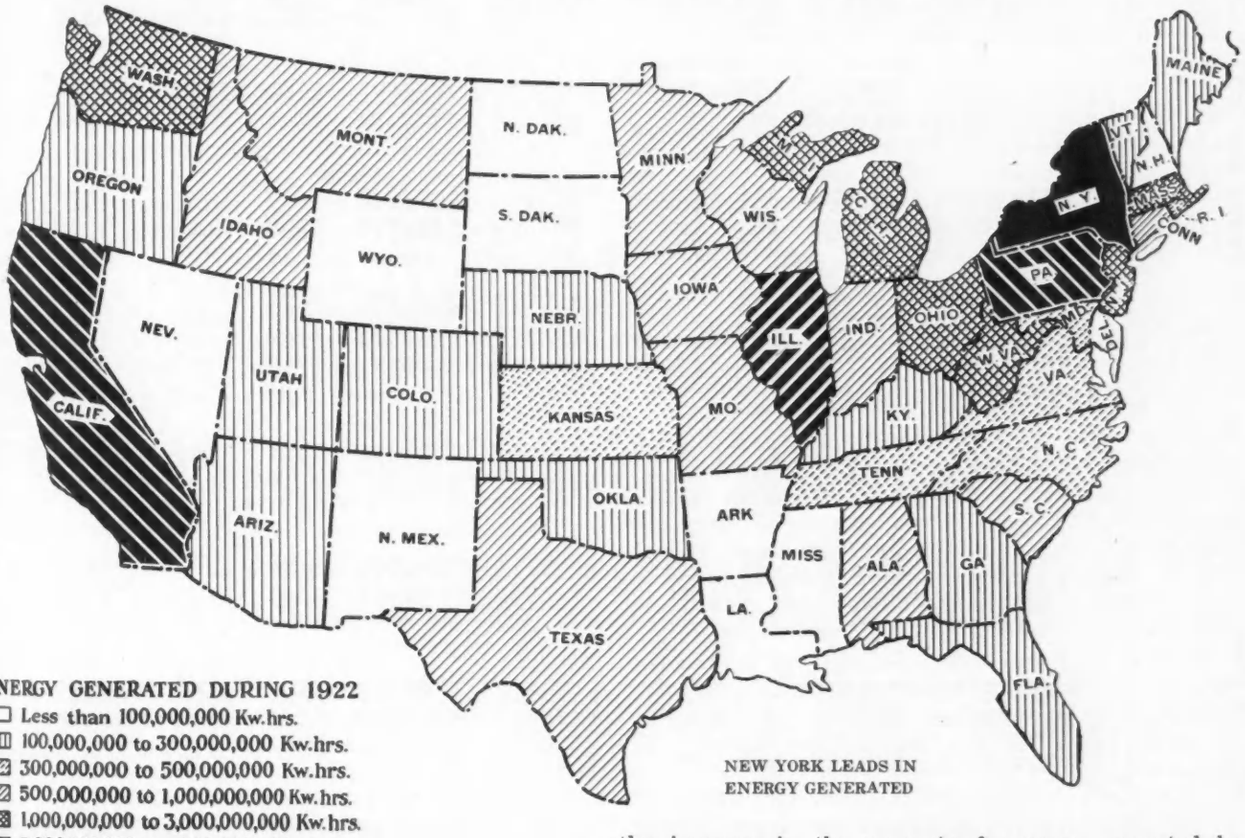
Large Growth Indicated by 1922 Census

Results of Census Bureau Survey Show the Continued Great Growth of the Industry—United States Has 6,355 Operating Systems and 5,444 Generating Plants

THE "1922 Census of Central Electric Light and Power Stations," which has just been issued by the United States Census Bureau, is a noteworthy contribution to the statistics of the industry. This report is very much fuller than those of the past, and the extended interpretations given in the text are to be commended. With this census report at hand, many of the estimates which have been based on the assumed growth subsequent to the census of 1917 can be corrected and the present statistics of the industry set on a more solid foundation.

The census finds that there were 6,355 operating systems in 1922, of which 3,774 were operated by commercial concerns and 2,581 were municipally operated. The relative importance of the municipal plants, however, is considerably lessened when the output of the two classes of systems is considered. The percentage which the output of the municipal systems, including energy purchased, formed of the total output of all systems decreased from 7.8 in 1902 to 4.9 in 1907, 4.6 in 1912 and 4.0 in 1917, and increased to 4.9 in 1922. Only sixteen municipal systems were reported in cities having a population of more than 100,000.

For the first time in any census period the number of commercial systems showed a decrease under the previous census. This decrease, however, which was due to the tendency toward concentration of the industry through mergers and combinations, did not imply any decline or slackening of the normal growth of the industry. The census indicates, on the contrary, that the increase in the amount of energy generated by commercial plants was greater than for any previous census period, the increase from 1917 to 1922 being 14,014,256,980 kw.-hr.



The report goes into considerable detail relative to the capital invested in the industry, giving detail figures on the "total assets" of the industry, which are placed at $5,793,237,945, the "aggregate capitalization of all systems" of $4,818,455,538, the "net capitalization of the commercial systems based on the electric light and power industry" at $3,873,366,969, and lastly the "value of plant and equipment," which is given as $235,659,668 and $4,229,356,023 for the municipal and commercial plants respectively. The ELECTRICAL WORLD estimated aggregate capitalization of the central-station industry, which was given as $5,100,000,000 on Jan. 1, 1923, appears to have been a little too high, but still close when it is remembered that the capitalization of the industry increased by almost a billion dollars during 1924 alone.

Present Status of the Electric Light and Power Industry as Gleaned from the 1922 Census of Central Stations

States	Number of Operating Companies: Commercial	Number of Operating Companies: Municipal	Number of Generating Stations: Commercial	Number of Generating Stations: Municipal	Value of Plant and Equipment: Commercial	Value of Plant and Equipment: Municipal	Rating of Generators in All Types of Central-Station Plants, Kw.	Energy Generated in All Central Stations, Kw.-Hr.	Total Primary Horsepower in Generating Plants	Number of Customers of All Classes	Total Gross Revenue	Total Expenses	Total Number of Employees	Coal Consumed by Central Stations: Bituminous Short Tons	Coal Consumed by Central Stations: Anthracite Long Tons
UNITED STATES	3,774	2,581	3,615	1,829	$4,229,356,023	$235,659,668	14,313,438	40,291,536,435	20,296,235	12,709,868	$1,072,119,883	$859,625,091	150,762	24,492,421	1,638,44[4]
New England	290	75	277	42	376,413,627	10,610,532	1,456,574	2,969,971,441	1,980,108	1,143,697	103,885,016	82,975,196	13,623	1,462,037	69,595
Middle Atlantic	465	128	433	79	1,135,190,804	9,466,197	3,664,986	10,765,515,044	5,505,573	3,242,775	309,134,582	245,419,078	47,150	6,327,907	1,522,817
East North Central	724	555	621	393	844,810,790	73,538,392	3,309,539	9,368,260,227	4,587,913	3,312,149	251,249,673	208,912,909	36,082	9,980,128	4,113
West North Central	802	920	705	594	416,998,401	38,169,278	1,171,496	2,968,756,855	1,610,393	1,561,211	106,829,718	87,499,041	15,282	2,589,413	23,773
South Atlantic	371	394	314	270	253,410,038	22,271,587	1,356,478	3,789,434,356	1,909,509	679,081	78,676,597	63,533,279	9,617	2,259,025	14,005
East South Central	266	161	269	149	176,338,474	8,571,363	573,738	1,419,833,684	716,817	362,982	32,570,832	25,780,853	4,538	1,089,198	2,271
West South Central	419	206	434	198	149,397,132	13,051,054	461,984	1,041,392,651	625,569	605,331	43,563,599	33,066,567	6,777	274,908	0
Mountain	257	94	307	69	277,026,514	4,788,180	661,376	2,209,444,164	1,005,405	445,270	41,039,550	30,330,423	5,432	462,881	120
Pacific	180	48	255	35	599,770,243	55,193,085	1,657,267	5,758,928,013	2,354,948	1,357,372	105,170,316	82,107,745	12,261	46,924	1,750
NEW ENGLAND															
Maine	75	7	66	6	39,260,016	565,859	89,983	278,456,249	128,453	92,733	5,865,424	4,558,886	1,244	5,404	0
New Hampshire	52	5	47	5	21,662,261	268,237	51,617	94,863,942	71,732	64,158	4,576,511	3,612,206	820	44,676	132
Vermont	42	15	55	13	27,857,065	1,584,320	96,866	217,717,589	138,745	48,320	4,560,870	3,691,498	747	3,322	0
Massachusetts	76	41	72	15	187,977,880	6,232,739	794,420	1,493,328,246	1,065,220	607,563	57,351,064	45,600,139	6,892	953,749	68,977
Rhode Island	7	1	5	0	28,013,573	18,000	163,900	341,592,302	221,773	86,271	10,151,677	8,134,049	1,056	14,695	0
Connecticut	38	6	32	3	71,642,832	1,941,377	259,788	544,013,113	354,185	244,652	21,379,470	17,378,418	2,864	440,191	486
MIDDLE ATLANTIC															
New York	232	59	217	37	603,417,260	4,744,882	1,858,890	5,430,771,804	2,684,130	1,760,418	158,785,893	125,127,483	26,011	2,054,785	117,057
New Jersey	42	18	49	13	141,618,531	1,725,038	356,443	1,058,089,737	475,426	428,934	42,634,490	34,230,895	4,911	1,126,837	84,555
Pennsylvania	191	51	167	29	390,155,013	2,996,277	1,449,653	4,276,653,503	2,346,017	1,053,423	107,714,199	86,060,700	16,238	3,146,285	1,321,205
EAST NORTH CENTRAL															
Ohio	157	141	99	77	208,916,846	15,574,331	897,412	2,404,492,455	1,212,379	774,605	68,445,019	54,903,440	8,492	2,494,942	2,680
Indiana	119	93	89	52	82,428,349	9,614,303	335,450	795,271,188	451,026	405,240	27,973,871	23,039,504	4,895	1,524,555	0
Illinois	163	121	123	106	254,532,156	25,673,603	972,550	3,089,503,612	1,404,935	1,127,830	79,765,986	67,648,723	11,977	3,804,948	10
Michigan	125	107	168	103	196,891,127	16,811,856	691,080	2,102,686,483	945,047	659,233	46,924,101	39,929,050	6,594	1,447,866	1,259
Wisconsin	160	93	142	55	102,042,312	5,864,299	413,047	976,306,489	574,526	345,241	28,140,696	23,392,192	4,124	707,817	164
WEST NORTH CENTRAL															
Minnesota	99	155	91	78	105,218,139	7,708,852	227,729	588,838,075	312,380	342,171	25,185,144	19,885,238	3,376	393,944	6,551
Iowa	148	146	116	72	99,858,844	4,250,209	236,036	858,542,890	330,657	298,911	19,499,856	15,711,635	2,474	489,481	0
Missouri	166	74	132	58	104,898,800	4,547,665	315,514	700,642,238	428,812	410,650	28,328,364	22,973,507	4,250	853,567	0
North Dakota	109	45	108	45	11,158,527	777,057	30,000	40,220,987	43,269	47,047	3,668,055	3,218,781	566	188,868	2,739
South Dakota	90	60	81	50	17,608,843	2,799,927	40,353	61,523,370	53,392	60,254	4,239,742	3,602,636	634	96,927	5,272
Nebraska	115	225	124	156	35,089,306	6,389,911	117,733	245,919,017	155,384	165,976	10,434,456	8,678,921	1,663	310,680	7,227
Kansas	75	215	53	135	43,165,942	11,695,657	204,131	473,070,278	286,499	236,202	15,474,101	13,428,323	2,319	255,946	1,984
SOUTH ATLANTIC															
Delaware, Dist. of Col. and Maryland	32	22	27	16	70,968,283	1,494,043	300,108	622,358,509	429,985	209,947	20,213,103	16,113,893	2,638	604,109	0
Virginia	69	30	7	6	20,950,927	2,847,627	117,272	319,206,325	163,232	61,182	6,721,365	5,391,409	976	224,238	18
West Virginia	57	9	48	8	46,907,234	195,500	300,463	1,199,378,080	392,722	74,069	16,221,240	14,747,608	1,550	1,066,123	0
North Carolina	85	97	79	54	39,656,109	5,481,685	167,421	404,428,045	231,035	106,392	15,188,387	11,531,388	1,412	272,142	0
South Carolina	40	47	51	27	37,229,538	2,675,998	292,880	844,416,989	448,782	61,685	8,828,162	6,683,909	940	[c]	0
Georgia	43	133	50	108	28,070,525	4,081,071	107,213	268,256,125	149,246	73,957	5,901,690	4,632,329	1,038	79,866	13,987
Florida	45	56	52	51	9,627,422	5,495,663	71,121	131,390,283	94,507	91,849	5,602,650	4,432,743	1,063	12,547	0
EAST SOUTH CENTRAL															
Kentucky	111	27	110	24	48,111,383	1,741,291	103,361	231,506,593	134,778	149,682	10,201,193	7,777,794	1,313	379,919	181
Tennessee	69	41	65	40	65,472,740	2,146,038	166,761	492,506,599	203,716	114,534	10,995,580	8,663,702	1,453	248,028	240
Alabama	39	33	50	26	52,971,960	1,420,389	261,431	633,883,203	319,766	54,549	8,061,664	6,750,136	1,171	354,230	0
Mississippi	47	60	44	59	9,782,391	3,263,645	42,185	61,937,289	58,557	44,217	3,312,395	2,589,221	601	107,021	1,850
WEST SOUTH CENTRAL															
Arkansas	63	24	67	24	13,649,585	1,459,609	42,239	84,469,023	57,130	56,096	4,277,260	3,413,364	709	60,737	0
Louisiana	37	44	39	44	10,407,135	3,446,876	32,838	52,156,221	44,252	58,901	3,558,983	2,597,892	609	6,203	0
Oklahoma	67	100	84	93	33,885,038	5,120,758	121,100	242,508,790	162,307	154,669	11,094,009	8,205,986	1,487	48,887	0
Texas	252	38	244	37	91,455,374	3,023,811	265,807	662,258,617	361,880	335,665	24,633,347	18,849,325	3,972	159,081	0
MOUNTAIN															
Montana	57	7	69	7	85,599,929	264,656	227,253	988,009,191	355,554	62,646	11,433,587	7,068,076	787	50,347	0
Idaho	28	14	43	5	36,440,297	921,620	[a]135,088	[a]531,134,238	[b]338,512	[b]156,127	[b]11,624,103	[b]9,454,454	[b]1,773	0	0
Wyoming	31	10	32	9	6,455,860	186,261	30,015	38,735,596	40,689	25,395	2,109,057	1,781,996	342	100,447	0
Colorado	51	28	47	22	55,216,609	1,615,288	112,590	290,081,677	152,685	132,708	9,537,304	6,854,053	1,498	252,890	120
New Mexico	26	5	27	5	4,494,911	294,185	15,178	22,362,386	20,198	18,834	1,417,855	1,290,024	266	55,582	0
Arizona	30	5	29	3	16,977,380	289,350	48,870	147,390,512	82,077	38,552	3,987,047	3,180,460	612	1,116	0
Utah	23	24	47	18	61,677,746	1,164,525	[a]81,347	146,337,419	[b].....	[b].....	[b].....	[b].....	[b].....	1,277	0
Nevada	11	1	13	0	10,163,782	52,295	11,035	45,393,145	15,690	11,008	930,597	701,360	154	1,222	0
PACIFIC															
Washington	66	14	70	8	86,301,526	24,466,034	362,576	1,144,068,589	512,264	260,610	18,855,417	13,013,510	2,361	44,653	1,750
Oregon	48	13	52	12	36,668,129	923,850	81,163	266,860,874	107,446	78,534	4,960,681	4,112,933	939	2,271	0
California	66	21	133	15	476,800,588	29,803,201	1,213,528	4,347,998,550	1,735,238	1,018,228	81,354,218	64,981,302	8,961	0	0

a—A large proportion of the energy generated in Idaho is exported to Utah for consumption. b—Utah data included with that for Idaho. c—Included with North Carolina.

The census gives some valuable and interesting data on the development of hydro-electric power, devoting an entire chapter to this subject. The figures indicate that the proportion which the number of kilowatt-hours generated by the hydro-electric plants bears to the number of kilowatt-hours for all plants increased from 50.5 per cent in 1912 to 54.7 per cent in 1917, but decreased to 46.4 per cent in 1922. The proportion for several other items, including rating of generators and prime movers, also shows increases from 1912 to 1917, followed by decreases during the succeeding five years. These figures are misleading, however, since one-third of the total power of the stations classified under "hydro-electric" is supplied by steam engines and turbines and internal-combustion engines. Some plants having waterwheels and turbines have been classified under "fuel power," but the output of these hydro-electric installations is less than 2 per cent of the total production of all fuel plants.

Hydro-electric systems are most numerous in the New England, Middle Atlantic, East North Central and Pacific divisions. New York reported the largest number of hydro-electric systems with thirty-one. Next in order are Wisconsin, Vermont, Michigan and California, with eighteen, seventeen, sixteen and fifteen respectively. The geographic distribution, however, differs greatly from that of the number of systems. California alone generated 22.3 per cent of the total output of the hydro-electric stations of the country, New York 15.3 per cent and Michigan 10.5 per cent. These three states alone contributed nearly one-half of the energy generated by the hydro-electric systems in the United States.

The average rate per kilowatt-hour for energy sold by the hydro-electric systems was 1.58 cents, which is equal to only a trifle more than half the average rate charged by systems other than hydro-electric.

a—A large proportion of the energy generated in Idaho is exported to Utah for consumption. b—Utah data included with that for Idaho. c—Included with North Carolina.

Letters from Our Readers

Suggests Definition of "Superpower"

To the Editor of the ELECTRICAL WORLD:

Frank G. Baum, in his letter to the ELECTRICAL WORLD published in the April 4 issue, has done a service in pointing out the great desirability of having a common understanding of the term "superpower." To some the word means only those developments that contain trunk transmission lines of very high voltage, to others it applies to systems having generating plants of the order of 200,000 kw. and more, but by the greater number the term seems to be used to denote electricity supply systems that are regional in extent, regardless of whether or not they have trunk lines of extra-high voltage. As implied in Mr. Baum's letter, an exact definition describing a specific type of development does not fit the case.

The many things to which, in several fields, the prefix "super" has been applied in the years since the war are but the natural developments in those fields. A greater size, or intensity, or area influenced is inevitable with progress, and so it is in the case of power. The use of the term in published writings has attached to it in the public mind a quality which is the real characteristic of electric power, for the electricity supply industry has brought an abundance of cheap and clean power to industries and comforts and conveniences to homes wherever its lines have gone. Electric power has this definitely to its credit. Certainly it is not illogical now to call that development "superpower" which is rapidly bringing these benefits to an ever-increasing number.

Such a definition would carry with it an appreciation of the social importance of the development already made and being increasingly made. It would show that the claims made for Pennsylvania "Giant Power" actually describe the present attributes of superpower, and with this understanding the picturesque reference to elephants in the Pennsylvania report loses its point. Superpower is in a degree a measuring stick of civilization's progress, and it is entirely proper for the industry to claim its share of credit for this progress. The definition of "superpower" should reflect this credit.

For the consideration of the industry and with a view to influencing its insertion in recognized standard dictionaries, I offer the following general definition for "superpower":

"Modern electricity supply systems in which electricity is economically generated in steam stations or water-power stations, or both, and is distributed for the benefit of population over wide areas."

Instead of objecting to the term, as some do, let us agree on a proper definition and then recognize it as belonging to us by right of accomplishment.

Commonwealth Edison Company,
Chicago, Ill.

R. F. SCHUCHARDT,
Electrical Engineer.

Wants More Data on Diesel Engines

To the Editor of the ELECTRICAL WORLD:

In the March 7 issue of the ELECTRICAL WORLD, under the title of "Diesels for Operation of Small Utilities," the author refers to a "certain class" of Diesel engine which is a cold-start, two-cycle, solid-injection machine and which is guaranteed by the manufacturers to produce a brake-horsepower-hour on 0.46 lb. of oil at full load. It is also asserted that a kilowatt-hour may be produced for less than 0.5 cent at 75 per cent of load.

The writer has had occasion to investigate the cost of current production on a number of these "better-class" semi-Diesel engines, and for some reason or other in all cases it has been a long way from 0.5 cent. The high-compression, solid-injection so-called Diesel referred to is a recent model and some "actual" operating cost figures would be interesting.

I would be interested in the fuel and lubricating oil requirements at one-half, one-fourth and lighter load ratings, these loads representing the operating condition existing in virtually all of the small utilities. Still, full load is generally conceded to be the point at which these "better-class" engines will operate successfully for any length of time. The author's opinion of a proper charge for obsolescence should be interesting, based on his experiences with oil engines, not only with the one which was moved about more or less during its twelve years of useful service, but on all of those which have come under his supervision. This engine was probably run down slightly in the spring of 1924, just before it was completely overhauled. It would be interesting to know something of the operating efficiency of this unit just before it was completely rebuilt.

Sioux City, Iowa.

C. E. MURPHY,
Power Engineer.

Central Station and Industrial Practice

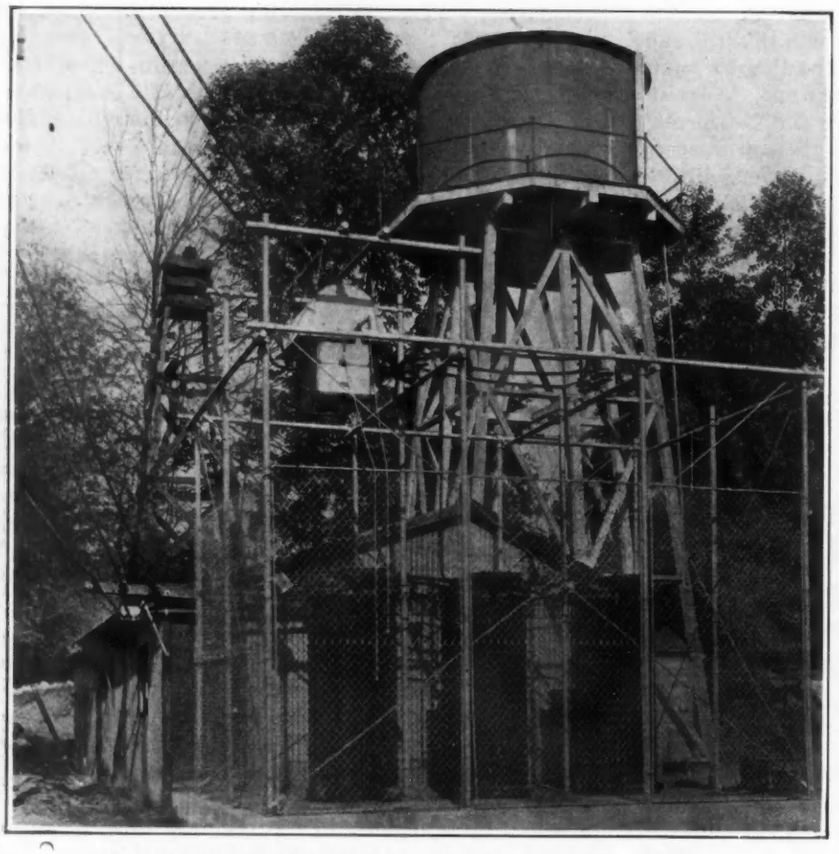
Inexpensive Industrial Substations

BY J. C. CAREY
Engineer Distribution Department, Southern California Edison Company, Los Angeles, Cal.

THE problem of making a proper installation of transformers on the premises of an industrial plant, oil company or other large consumer has been worked out by the Southern California Edison Company in a way which should interest other central stations. This type of installation meets the requirements of economy and satisfactory appearance and also the most essential requirement of fireproof construction.

The accompanying illustration shows an installation at a large pumping plant and gives a general idea of the substation. The frame of 2-in. galvanized-iron pipe is 12 ft. x 18 ft. in floor area and 14 ft. in height. At one corner the frame is carried to a height of 17 ft. to provide required clearance above ground for the high-voltage service wires. These dimensions provide ample room for three transformers of 500 kva. capacity each. The rack is inclosed by a woven-wire fence 10 ft. high strung on the upright members of the rack itself.

This reduces the space set aside by the consumer, which is quite an advantage when making an installation in congested manufacturing districts. Three panels 6 ft. wide on ¾-in. pipe framing are removable to allow access to the inclosure and the removal of equipment. Clamp fittings are used throughout, eliminating drilling and threading in the field. The pipe is cut to dimensions before being sent to the job.



PUMPING PLANT INSTALLATION CONSISTING OF THREE 200-KVA., 16,000/400-VOLT TRANSFORMERS

A 16-kv. type "Y" Kellman oil switch is used on the primary side of the transformers and a pole-top disconnecting switch is installed on the last pole. Varnished-cambric weatherproof cable is used for the tap from the 16-kv. line and for the 16,000-volt bus. The 440-volt secondary leads connect directly to the consumer's conduit service on the low side of the transformers.

The average cost of an installation of this type is $180 for material, exclusive of oil switch, transformers and concrete foundations, and $120 for labor, which includes all connecting up of transformers and switch.

Thermometer Stem Correction

BY E. L. KARKAU*

SOME months ago in the middle of a boiler test the full-immersion thermometers used to read degrees superheat were broken and replaced by 3-in. immersion-at-70-deg. thermometers, these being the only instruments on hand. The ordinary formula for stem corrections used on total-immersion thermometers does not clearly show how to handle stem corrections for a thermometer corrected by the makers, say, with a 3-in. immersion at 70 deg. This ordinary formula is:

C scale correction $= 0.00016\ n\ (T-t)$,
F scale correction $= 0.000088\ n\ (T-t)$,

where n equals the degrees projecting above bath, T the temperature of bulb and t the mean temperature of emergent stem taken by an auxiliary thermometer.

To calculate the superheat from the data shown, the following formulas were used:

Data.—With the right well immersed to 265 deg. the *F* bulb reading was 643.4 deg. This was with the 3-in. point reading 60 deg. and 200.1 deg. the mean temperature of stem. With the left well immersed to 325 deg. the *Fb* bulb reading was 636.5 deg. This was with the 3-in. point reading 60 deg. and 259.8 deg. the mean temperature of stem.

Right-well correction:

$$0.000088\ (70-643.4)\ (265-60) = -10.344,$$
$$0.000088\ (70-200.1)\ (643.4-265) = -4.33,$$
$$\text{Total correction} = -14.674.$$

Left-well correction:

$$0.000088\ (70-636.5)\ (325-60) = -13.21,$$
$$0.000088\ (70-259.8)\ (636.5-325) = -5.202,$$
$$\text{Total correction} = -18.412.$$

Right-well temperature $= 628.72 - 14.674 = 628.72$ deg. F.
Left-well temperature $= 636.5 - 18.412 = 618.088$ deg. F.

The theory on which this is based is that the part of the stem immersed

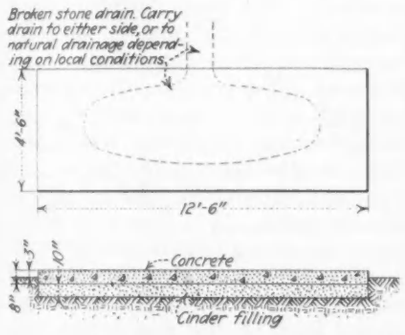
*Assistant test engineer Ottawa Street station, Board of Water and Electric Light Commissioners, Lansing, Mich.

above 60 deg. is hotter by 573.4 deg. than it was calibrated for and that the part of the thermometer above the immersion point and the actual position of the mercury is hotter by 130.1 deg. than the reading the stem was calibrated for.

The final corrected temperatures check very closely with those obtained by the total-immersion type of thermometer.

Standard Concrete Platform Specifications

THE standard concrete platform for the transformer installation shown herewith has been added to the standards on overhead distribution construction of the West Penn Power Company since that series was run in the ELECTRICAL WORLD. When built according to the specifi-



CONCRETE PLATFORM FOR TRANSFORMER SUBSTATION

cations in these standards, this platform consists of a layer of cinders or equivalent at least 10 in. in thickness, the top of which is below ground level. The cinders are washed down and well tamped.

A wooden form, which extends 3 in. above the ground level, is used for the concrete. The concrete mixture is in the proportions of one to two and a half to five and is turned three times dry and two times after the water has been added. The surface has sufficient grout of one-to-two mixture deposited before the initial "set" of the concrete in slab has taken place, and the whole is floated to the surface without unnecessary loss of time. The amount of material necessary for the foundation of this platform is given in the table.

NECESSARY MATERIAL FOR PLATFORM

Concrete		Foundation	
Cement.....	8 bags	Cinders.....	2 cu.yd.
Sand.....	1 cu.yd.	Stone.....	1 cu.yd.
Gravel.....	1½ cu.yd.		

New 220-Kv. Switch Stands Tests

Motor-Operated Disconnecting Switch Was Designed to Meet Severe Weather Conditions—Details of Switch and Description of Tests

MUCH serious thought has been given in the last few years to the essentials that go to make up a 220,000-volt superpower network. Such a system necessarily involves very large blocks of power and for that reason must have a greater degree of reliability than can be economically justified in a less important system.

One of the important essentials that go to make up such a system is the disconnecting switch. It must for economic reasons be mounted outdoors and is, therefore, exposed to all manner of weather conditions. Due to the unusually large dimensions required to obtain proper electrical clearances, special consideration must be given to the mechanical features.

Engineers called upon to select a switch most suitable for such service have considered it difficult to fix on a design merely from drawings or models and have therefore asked a number of interested manufacturers each to build, erect and operate a full-sized three-pole motor-operated switch for inspection and a study of its behavior during long periods of continuous operation at normal and also double operating speed.

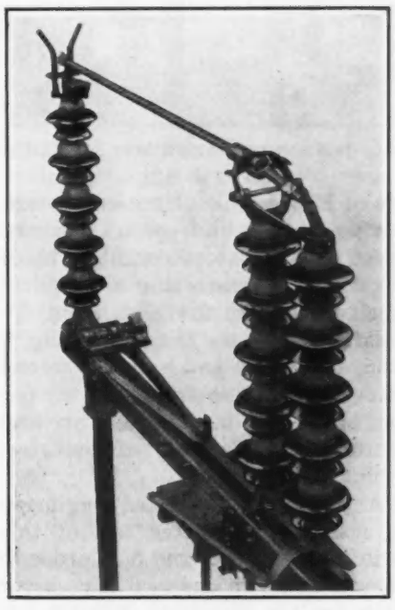
These engineers have decided that a minimum ground clearance of 72 in. and a metal-to-metal clearance of 9 ft. 6 in. in the open position of the switch be maintained, also that the switch be motor operated at a normal speed of twelve seconds opening and twelve seconds closing, with a current rating of at least 400 amp.

The Railway & Industrial Engineering Company of Greensburg, Pa., has recently made a 220-kv. switch, making use of a rotating tubular blade, which is claimed to embody the essentials necessary to produce a reliable mechanical mechanism to meet severe weather conditions.

The contact end of the blade is provided with a hollow flat end or "beaver-tail" of aluminum bronze 4 in. wide, 1¼ in. thick and about 5 in. long, with a shank pressed into and riveted to the end of the tubular copper blade 2-in. outside diameter No. 14 Stubs wall thickness. In the closed position of the switch this "beaver-tail" is jammed between the tubular copper jaws with a total contact pressure of 400 lb.

In opening the switch the blade is first rotated through an angle of 60 deg., thereby releasing the contact pressure and breaking out the ice before the blade is called upon to lift. This rotation of the blade is positive, being produced by the first 30 deg. rotation of the rotating insulator at the back end of the switch, the blade being subsequently opened to 7½ deg. beyond center by the final 60 deg. rotation of the insulator.

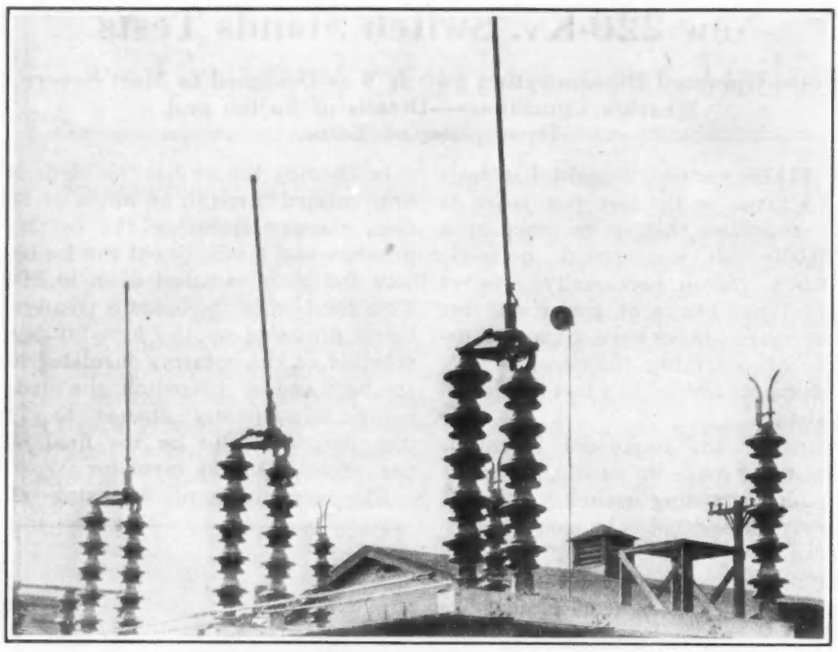
The advantage of releasing all pressure at the jaw is very evident when it is realized that the blade is 10 ft. 8 in. between the hinge and center of jaw. If the usual jaw friction and ice locking had to be contended with, the strains on the insulators would be excessive.



MODEL WITH GROUNDING SWITCH SHOWING DETAILS OF CONSTRUCTION

The design of the jaw contact is distinctly novel and has naturally been the subject of some speculation. It was thought that the line contact produced would produce excessive heating and wear. However, tests on smaller sizes have shown that this contact will carry from 800 to 1,000 amp. without exceeding 30 deg. C. rise. The contact pressure is approximately 400 lb. and the wear is compensated by facing the 1¼-in. outside diameter tubular copper jaws with cast aluminum-bronze shoes having 1¾-in. face.

All the essential mechanical parts of the switch above the insulators



DISCONNECTING SWITCH FOR 220 KV. WITH BLADES IN OPENED POSITION

are of high-tensile aluminum bronze, having also a high elongation and great resistance to shock. The blade has a double reinforcing of seamless steel within, the first extending approximately 80 per cent of the length from the hinge end and the second being within this for about 40 per cent of the length. The jaws are also reinforced within with seamless steel tubing.

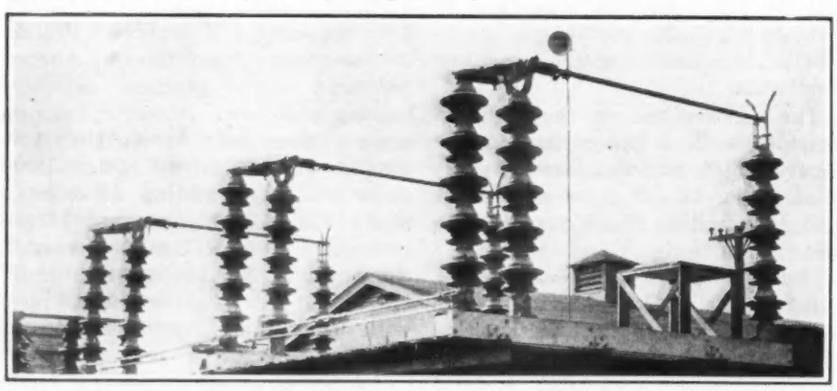
A group of interested engineers witnessed a protracted test of this switch on March 2 and 3 in order to determine its mechanical fitness for duty on the proposed 220,000-volt systems. It was operated continuously from 11:45 a.m. March 2 to 11:45 a.m. March 3, the controls to the motor contactors being equipped with a special relay which started the switch in the opposite direction a few seconds after an operation was completed. During this period a cycle counter attached to the switch indicated 3,186 complete openings and closings and a direct-current watt-hour meter on the 1-hp. motor showed a total consumption of 13.5 kw.-hr., or 4.17 watt-hours per cycle of operation. The speed of operation was ten seconds to open and nine seconds to close.

Subsequently the switch was operated at a six-second speed for one hour, making 186 complete cycles with a current consumption of 0.833 kw.-hr. or 4.48 watt-hours per cycle of operation.

The prevailing temperature during the test averaged about 12 deg. C. below zero. Before starting the test on the morning of March 2, the switch was sprayed to form an artificial sleet to a thickness of ¼ to ½ in. Before the completion of the twenty-four-hour test the motor mechanism and the auxiliary switch were sprayed from a hose nozzle and the cases were found to be tight.

It is very gratifying to note that no part of the switch or mechanism failed in any particular, with a minor exception of the flexible leads to the rotating tubular blade, which did not stand the twisting and bending.

The "beaver-tail" blade contacts showed a maximum of 0.005 in. wear without lubrication and on the aluminum-bronze shoes on the tubular jaws only a slight depression was produced.



NEW 220-KV. SWITCH HAS "BEAVER-TAIL" BLADE CONTACTS

Remedies for Tower-Footing Corrosion

BY E. H. STEELE
Engineer Line Construction, Pacific Gas & Electric Company, San Francisco, Cal.

IN THE construction of steel-tower transmission lines the preservation and life of the steel footings which are carried below the surface of the ground and form an integral part of the foundation are very important considerations in tower-line construction. The galvanized structure above ground is almost entirely free from the corrosive effects of the elements, from which unprotected material suffers very severely, especially along the Coast, where salt fogs are prevalent. The structures thus galvanized have had an almost indefinite life. It is therefore essential to provide a foundation that will insure a life of the footing material equal to that of the upper structure. If any part of the foundation material on steel structures is affected, requiring replacements in, say, from fifteen to twenty years, much of the maintenance expense which it was sought to avoid has been defeated.

The general practice of foundation work for transmission purposes is in two distinct classes:

1. A metal footing, all galvanized, placed in natural soils of the country to be crossed, relying entirely upon the earth for foundation purposes and with no other protection for the metal surface than the galvanizing.

2. The metal footing incased in concrete material below the ground line, this footing being ungalvanized except on the exposed areas above the ground line.

Under the first method experience of the Pacific Gas & Electric Company has demonstrated that corrosion has been found to take place rapidly where the soils are of an alkaline nature or carry any great amount of salts. The rapidity with which metal is attacked depends, of course, upon the amount of alkali or salts in the soils. Galvanizing the metal does not seem to protect it when subjected to alkali. Under the more severe con-

ditions it has been found that the metal stubs have been so completely eaten up through corrosion within fifteen to eighteen years that it has been necessary to replace them.

Where the conditions are not so severe an effort has been made to protect the metal surface of the stub further by removing the earth sufficiently to permit of cleaning the metal surface thus attacked and painting it with a heavy coating of tar paint, a byproduct which can be secured from any gas plant. This method of protecting the stub against corrosion has not been under observation for a period long enough to determine definite results, but it is hoped that it will retard, if not wholly eliminate, corrosion. Corrosion will still continue if the metal parts are not first thoroughly cleaned or not cleaned uniformly before being protected.

In the second method of placing the tower footing it is incased wholly in a mass of concrete which protects it from the changing soil conditions and the effects of the corresponding wet and dry periods. With the footing thus placed in concrete, it is unnecessary to galvanize the footing for more than 18 in. below the point where it enters the concrete material. With this construction a life of the stub equal to the structure above the ground is assured. Care, however, must be taken to see that a convex shape is given to the top of the concrete pier where the stub enters rather than a concave or flattened surface, in order to prevent water pockets forming on top of the pier. Where tower foundations are on a side hill this will also prevent the drainage from these surfaces being carried down around the tower footing, thus allowing water to stand in direct contact with the exposed galvanized surface. If this were to happen, the same detrimental effects would occur that are mentioned in the description of the first method of placing the footings, provided the water thus confined around the tower footing carried alkali or salts.

A question may be asked regarding the sherardizing of material for this class of work. It has been found by experience where sherardized bolts ½ in. in diameter have been exposed to the most severe conditions that the bolt has been entirely destroyed within five to six years. It is felt, therefore, by the writer that sherardizing for protection under such conditions is of little value.

Starting-Current Limits

THE New York Edison Company for several years has enforced rules limiting the starting current for motors supplied from its underground networks. These rules are interesting, because they have been made necessary by the increased and varied use of motors.

About fifteen years ago the motors served from the underground system were of small size and were used in work that required a low starting current. As the size of motors increased and their use was broadened, various applications were made that required motors of excessive size for an ordinary installation and that required an unusually large starting current.

This unusual motor load was also shifted from one part of the system to another as the power customers shifted their business quarters. There are comparatively few large power users in New York proper and most of the motor load is located in the so-called "lofts" in the buildings throughout the city. As there is a great deal of shifting of location by power users during the year, there is also a great variation in power loads on different parts of the system.

The New York Edison Company, therefore, established ample starting current limits for motors up to 50 hp. and ruled that starting current for motors under 50 hp. which exceeded the limit for its particular size and for motors of over 50 hp. must be taken in increments of not more than 94 amp. per one-half second by use of some type of compensator. The starting-current limits set are in general greater than the N.E.L.A. starting-current standards and it is found that only special applications such as cement-mixing and refrigerating or highly overmotored plants are affected.

Wooden-Pole Construction

THIS 22-kv. line construction saves an extra cross-arm and the necessity for increasing height of poles. It has been used extensively by the Great Western Power Company in cases where poles were not of sufficient height to add a second circuit on standard cross-arm construction without replacing the poles.

Size and Type of Fuses for Transformers

THE data for fusing transmission and distribution transformers given in the two accompanying tables have been adopted by the Utica Gas & Electric Company as its standard practice. As is seen, these tables give the transformer rating, type of fuse box, cut-out or oil switch, full-load current, size and type of fuse. Table I is for fusing of 2,300 transformers, while Table II is for 4,000-volt transformers.

TABLE I—FUSING OF 2,300-VOLT TRANSFORMERS

Transformer Kva.	Type of Fuse Box or Cut-out	Full Load, Amp.	Size of Fuse, Amp.	Type of Fuse
1½	G. E. plug cutout No. 104,227	0.65	5	String
3		1.30	5	String
5		2.2	10	String
7½		3.3	15	String
10		4.3	20	String
15		6.5	25	String
25	Mathews 100-amp., type OK	10.9	50	Mathews twisted
37½		16.3	70	Mathews twisted
50		21.8	80	Mathews twisted
75	Mathews 200-amp. type HQ	32.6	130	Mathews twisted
100		43.5	180	Mathews twisted
150	Oil switch	65	...	.....
200		87	...	.....

Fuse stock for distribution transformers: A—String fuse—5, 10, 15, 20, 25 amp. B—Mathews fuses for type OK, 100 amp., box 30, 40, 50, 70, 80, 100 amp. C—Mathews fuses for type HQ, 200 amp., box 130, 150, 180, 200 amp.

TABLE II—FUSING OF 4,000-VOLT TRANSFORMERS

Transformer Kva.	Type of Fuse Box or Cut-out	Full Load, Amp.	Size of Fuse, Amp.	Type of Fuse
1½	G. E. plug cut-out No. 104,227	0.375	5	String
3		0.75	5	String
5		1.25	5	String
7½		1.875	10	String
10		2.5	10	String
15		3.75	15	String
25	Mathews 100-amp. type OK	6.25	30	Mathews twisted
37½		9.38	40	Mathews twisted
50		12.5	50	Mathews twisted
75		18.75	80	Mathews twisted
100		25.0	100	Mathews twisted
150	Mathews 200-amp., type HQ	37.5	150	Mathews twisted
200		50.0	200	Mathews twisted

Fuse stock for distribution transformers: A—String fuse—5, 10, 15, 20, 25 amp. B—Mathews fuse for type OK, 100 amp., box 30, 40, 50, 70, 80, 100 amp. C—Mathews fuses for type HQ, 200 amp., box 130, 150, 180, 200 amp.

Commercial Activities and Public Relations

Productive Load-Development Policy

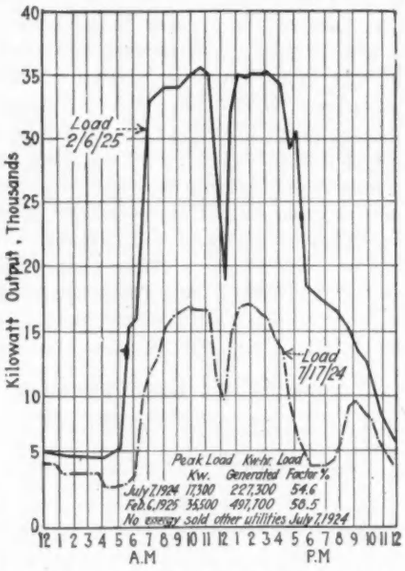
Cultivating Business on Existing Circuits, Attention to Small Customers and Promotion of Industrial Electric Heating and Power Loads

BY FRED H. SMITH
Vice-President Worcester (Mass.) Electric Light Company

THE problem of economic load building on a central-station system serving a highly diversified territory centers upon the maximum use of the existing investment in plant and distribution facilities. It is of primary importance to develop existing lines into channels of multiplied service and to go after "volume business" on all circuits up to their economic capacity. For more than a decade the policy of the Worcester Electric Light Company has been to stimulate the intensive cultivation of business on established feeders coincidently with the development of new service to streets formerly nonexistent or else thinly settled. Today there is scarcely a street in the city not reached by our lines, and as few cities in the country exhibit a greater variety of industries in proportion to their population and area, if not *in toto*, our sales department is not restricted in the cultivation of new business as in less favorably circumstanced companies.

By cultivating loads on established circuits the investment turnover is increased, and at present we see no danger of developing a "lopsided" load. Our generating plant load shows ample margin for new business of diversified classes. During the past few years we have devoted much sales effort to residential service, and this business was a remarkably stabilizing factor in the industrial depression of 1924. Our total sales of energy to residences last year were 11,441,603 kw.-hr., a gain of 15.9 per cent over 1923. Power sales in 1924, exclusive of sales to the New England Power Company, totaled 43,099,314 kw.-hr., or a loss of 9.1 per cent. Our income from residence energy sales last year was $876,648.82, and from power sales $993,017.26. One class was nearly as important as the other from the revenue standpoint.

Our "normal" weekday (Monday to Friday) curves have a sort of family resemblance without much regard to the season of the year. This can be seen by comparing the accompanying curves for July 17, 1924, and February 6, 1925. Our day load does not here show violent variations in the busy hours of either morning or afternoon, and the station load-factor was 54.6 per cent for the first day and 58.6 per cent for the second. Our yearly load factor for 1924 was



LOAD CURVES WORCESTER ELECTRIC LIGHT COMPANY

26.7 per cent (the yearly peak was 35,400 kw. and yearly average hourly load 9,440 kw.). The influence of week ends, holidays and power interchange is of course marked.

We can develop a very large increase in residential service on existing lines and be making greater use of our investment. Emphasis is being laid on instructions to the appliance department to feature sales of irons, toasters, percolators and portable lamps. The merchandising profit per article on these devices is smaller as a rule than in selling washers and cleaners, but these higher-wattage appliances are more valuable as load builders and the point of saturation seems far off. In like manner the development of long-hour window and sign lighting business and of industrial electric heating service helps to fill the valleys of our load curve. Conditions in the Worcester area have not required the establishment of off-peak or night-power rates, and there is little opportunity for the development of the electric pumping load so helpful in improving load factors.

For the company serving a territory of low load diversity the new-business work must take particular account of the plant peak in order to avoid unbalancing station resources and being forced to expand the investment too rapidly in proportion to revenue. To such properties the intensive development of economic loads on existing lines should make a strong appeal, even as this policy is the soundest one to be pursued by utilities serving highly varied industries and businesses.

Home Service Organized for Utility's Customers

TO SHOW customers how to obtain the most convenient and economical utilization of its service the Central Hudson System of gas and electric companies, with headquarters at Poughkeepsie, N. Y., has organized a home service department. Its scope will include helping in every way possible with the activities connected with home making, especially when they are related to the companies' service.

A definite program will be put into effect immediately in the different districts of the territory served by this group of utility companies. Classes in practical housekeeping will be formed, personal visits will be made to homes, and co-operative work will be carried on with the schools, churches, clubs and community organizations.

A staff of experts in home economics has been engaged to carry on this activity throughout the central Hudson region. The home service women are all college-trained in their profession and are experienced in practical cookery, household art and management, as well as being specialists in the use of both electric and gas appliances. The work is under the general supervision of Miss Ina B. Rowe.

NEW COMMERCIAL LIGHTING UNITS REPLACE OBSOLETE CLUSTERS IN READING ROOM OF PUBLIC LIBRARY AT DANVILLE, IND.

Profitable Commercial Light Campaign

In Twenty-one Days 988 Store Lighting Units Are Sold at a Net Profit of 10 per Cent, Adding More than $9,000 Annual Revenue—Public Buildings Adopt Equipment

BY A. C. CRANDALL,
Sales Manager Central Indiana Power Company Subsidiaries, Indianapolis

A COMMERCIAL lighting campaign recently conducted in the territory served by the subsidiaries of the Central Indiana Power Company resulted in the sale of 988 units in twenty-one days. Interesting results of the campaign were a net merchandising profit of 10 per cent, adoption of the commercial units for the public buildings in small communities, and the development of latent sales ability in company personnel.

The campaign was built around a commercial unit ranging from 100 watts to 750 watts in size. The salesmen made a preliminary survey of every commercial lighting customer, which was used as a basis for determining the size and number of units to be recommended to the prospect. These surveys were not elaborate, but gave enough data for an intelligent recommendation, provided an entrée to the prospects, established a definite basis on which to build a sales argument and, in cases of no sales, served as prospect data sheets for future efforts. Three separate broadsides were mailed at intervals of a week and were so timed as to permit the salesmen to follow up the publicity within two days after the third broadside was received by the prospect.

Evidence that these sales campaigns bring out the men's best efforts was shown in the record of one of the district managers. This manager, without any sales organization and with only the efforts of himself and such employees as he could interest, set out to make his quota. The lighting units were installed on ten days' free trial and time payments. Three days before the close of the campaign this manager experienced several rejects by prospects who did not wish to keep their installations. It looked like no quota for this district. To have these rejections come just when the goal was in sight so irritated this manager-salesman that he went out and sold in one day three times the number of rejections received, sold them for cash and exceeded his quota.

FINANCIAL SUMMARY, COMMERCIAL LIGHT CAMPAIGN

Sales		$11,445.40
Expenses:		
Cost of units sold	$5,713.08	
Miscellaneous sales material cost	200.00	
Bonuses and special commissions	269.25	
Prizes	250.00	
Advertising	1,067.90	
Hanging fixtures	775.55	
Interest and carrying charge	494.00	
Freight, hangers	240.75	
Traveling expenses	150.00	
Salesmen's commissions	843.00	
Miscellaneous additional expense	300.00	
		10,303.53
Net profit		$1,141.87
Increased earnings:		
Increased connected load, 95,185 watts.		
Estimated burning hours, 1,200 annually.		
Estimated increased consumption, 114,211 kw.-hr. annually.		
Estimated increased earning, average 8-cent rate		$9,136.88
Estimated increased earning from contractor's sales		648.00
Total increased earnings.		$9,784.88

In small communities the public buildings are often miserably lighted. Scarcity of funds and the small size of the lighting installations does not encourage intensive development by out-of-town specialists. The commercial lighting campaign uncovered several institutions that were in sore need of the "lighting doctor," but which had thought themselves unable to pay the cost of specialized service. The commercial unit made it possible to give these buildings good illumination at a very low cost.

The accompanying illustration of the public library at Danville, Ind., shows the improvement in appearance when old cluster fixtures were replaced by the new units, which raised the illumination from two to five foot-candles. An interesting feature of this installation is the fact that there was no increase in the connected lighting load, because of the increased efficiency of the new lamps. The lighting company has, however, gained in revenue, because the public has been so pleased with the new illumination that it insists on burning the lamps more hours.

In view of the benefit to the sales force and the community from this campaign it was encouraging to find that a net merchandise profit of 10 per cent has been realized. The campaign added nearly 100 kw. to the connected lighting load, which, with an average burning period of 1,200 hours per year, has resulted in an increased consumption of 114,000 kw.-hr. At an average rate of eight cents per kilowatt-hour this added consumption resulted in increased earnings of more than $9,000. In addition to the units sold by the company, there were many units

sold by contractors during the campaign, and these units brought with them added earnings from kilowatt-hour sales. The accompanying brief financial summary of the campaign shows its cost, net profit from sales and estimated revenue from the additional lighting load.

Range Users Good Refrigerator Prospects

Texas Utility Finds Low Sales Resistance to Electric Refrigerators—Easy Payment Plan Offered—Annual Consumption 800 Kw.-Hr. per Machine

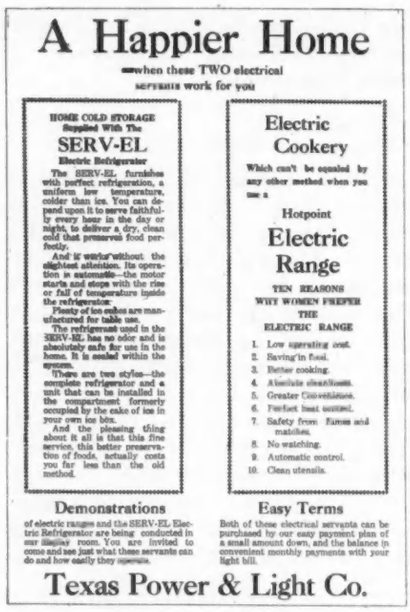
BY G. B. RICHARDSON
Manager Merchandise Sales, Texas Power & Light Company, Dallas, Tex.

ELECTRIC refrigeration for the home and store fully deserves the indorsement of the electric utility, and equipment is now available that is reliable in operation and that can be sold at such price and terms of payment as will fully justify its use. Because of its excellent load characteristics electric refrigeration will justify unusual activity on the part of the management and especially the commercial department of electric utilities. An electric refrigerator in the store and home will do much to increase the returns to the central station from residential and commercial lighting business.

The Texas Power & Light Company, having carefully investigated the market for electric refrigerating units and having checked the value of this load to the company and the value of the service to the purchaser, determined upon an aggressive selling campaign that would equal the efforts and results of electric-range sales. The electric-range campaign was carried through under conditions far more adverse than will be experienced with electric refrigeration, because in the case of the range, natural gas at a very low rate was available in many of the communities served. Even under this handicap approximately 7,000 electric ranges have been placed on the lines of the Texas Power & Light Company during the past few years.

With electric refrigeration for the home, the company is in position to offer a valuable service at a cost actually lower than any other method. This is of importance to the housewife, who is anxious to know the effect the installation of an appliance will have on her operating budget.

In developing a selling plan sales resistance has been reduced through partial payment extended over a period of about two years. A complete electric refrigerating unit, including a well-built refrigerator of ample capacity for the average home, can be purchased from the company on terms as low as $15 down and $15 per month. As most of the communities in which this company operates are small, the regular selling force used in the sale of other merchandise is employed in the sale of refrigerators. Special salesmen with headquarters in Dallas are available for campaign work and to assist the local selling organization in closing the more difficult transactions.



AN ELECTRIC REFRIGERATOR MAKES AN IDEAL RUNNING MATE FOR AN ELECTRIC RANGE

It is the object of the sales organization to place an electric refrigerator unit in every home where an electric range is in service. Advertising copy has been used to associate the appeal of the electric refrigerator with that of the electric range. On account of the easy terms of purchase we consider every range user a prospect for an electric refrigerator.

We also have the small store, the ice cream and soda fountain and many other applications for electric refrigerators, which should provide a market almost without limit.

The company's experience to date is such that little service expense is looked for where machines have been properly installed and where systematic inspection is provided. Preliminary information on servicing requirements was obtained from our operating department and from other companies that have had longer experience with these machines, and the company is so well satisfied with the machines now on the market that guarantees are issued with every refrigerating unit covering satisfactory performance or full refund of purchase price.

Refrigerating units in convenient sizes for the small home and the apartment have had the largest sales. Our experience shows an average energy consumption of 2 kw.-hr. per day, or approximately 800 kw.-hr. per year. The load factor of the individual machine has been found to be close to 30 per cent. The composite load factor of a number of machines is, of course, much better. On our rates we receive a gross income of approximately $35 a year from each machine. This revenue is obtained at very little cost to the operating department, and the merchandising profit covers all sales expense. It is confidently expected that the electric refrigerating department within a few years will have become one of the most important divisions of the company.

Ten-Day Stock Sale Adds 1,280 New Shareholders

IN A RECENT customer-ownership campaign the Winnipeg (Man.) Electric Company added 1,280 new stockholders and exceeded by almost 50 per cent the number of shares it originally set out to sell. Although advertised as a ten-day sale with 2,000 shares of the company's preferred stock offered, the whole allotment had been sold before the end of the fifth day. In all 2,845 shares were sold.

The stock was sold entirely by employees of the company—motormen, conductors, linemen, clerks, meter readers, stenographers, etc.

It was the policy of the company to sell not more than five shares to any one customer, and rigid observance of this rule resulted in wide distribution of the stock. The new stockholders comprise men and women in all walks of life residing in all sections of the community. It is estimated that as a result of this campaign the number of preferred stockholders was approximately doubled.

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

Test Code for Centrifugal and Rotary Pumps.—A tentative code has been developed for standardizing the method of determining efficiency and output. It is one of a series of test codes for the various prime movers and auxiliaries which constitute power-plant equipment. — *Mechanical Engineering*, March, 1925.

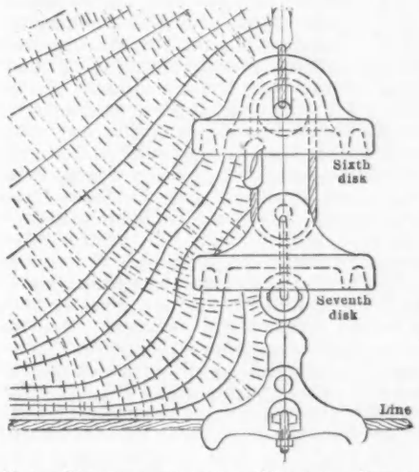
Large Curtis Turbines.—O. F. JUNGGREN.—This paper is in the nature of a supplement to the one by Hodgkinson presented last summer before the World Power Conference in which much attention was given to machines of the Parsons type. The development is summarized in three classes: (1) Turbines made with the Curtis combined velocity stages throughout, mostly of the vertical type with comparatively few stages and running at slow speed, manufactured from 1902 to 1914 in sizes up to 20,000 kw.; (2) those having one combined velocity stage with a varying number of single wheels; (3) those with single wheels throughout and with conical construction of the rotor, put on the market in 1915. Cross-sections of several recent turbines of the last-named class are shown, ranging from 17,000 kw. to 45,000 kw., together with test data on steam consumption of five units installed in various plants. One of these shows a water rate of 9.32 lb. per kilowatt-hour when operated at 300 lb., 707 deg. F., 1 in. exhaust pressure, on a load of 29,500 kw. For a lower-pressure machine the corresponding figures are 11.00, 210, 503.5, 25,500.—*Power*, Feb. 24, 1925.

Developing a 14,000-Hp. Water-Power Project 9,000 Ft. Above Sea Level.—ROBERT R. BENSON.—An illustrated descriptive account of the difficulties of plant construction when material had to be hauled over many miles of deep volcanic dust, on which no form of permanent roadway could be made to hold, on the east slope of the Sierra Nevada Mountains in California.—*Power*, Feb. 24, 1925.

Transmission, Substations and Distribution

Scherbius-Controlled Induction-Synchronous Frequency Converter.—R. E. GREENE.—The 6,000-kw. sets here described are installed at Rochester, N. Y., as a tie between adjacent 25-cycle and 60-cycle systems and will permit a total variation of 9 per cent in the two frequencies. Instead of depending on an adjustment of the secondary resistance in the induction-motor member to control the power interchange between the systems, the Scherbius machine introduces into the secondary circuit a voltage of slip frequency whose magnitude and phase angle are controlled by the operator. This voltage is obtained from the commutator of a regulating motor of the polyphase commutator type, of which the fields are excited at slip frequency from the ohmic-drop exciter. The action is explained with the aid of diagrams of connections. — *Power*, Feb. 17, 1925.

Measurement of the Electric Field on Insulator Chains.—D. I. REGERBIS.—A new method for determining the form and magnitude of the electrostatic field along chains of suspension type insulators apparently surmounting many former difficulties encountered has been suggested by Professor Toepler, and was investigated by the author of this article. A feature of it is the fact that no instruments, spark gaps or any kind of metallic connections are needed to find the field. As a detector for the field a piece of straw ¾ in. long is used, which is drilled through its middle and a ½-in. steel needle, going through this hole, serves as a fulcrum. Just enough clearance is given between this steel shaft and the



FIELD DISTRIBUTION ON A HEWLETT CHAIN AS DETERMINED BY NEW METHOD

bore through the straw to permit the latter to swing, like a magnetic inclination needle, freely around its center of gravity. To each end of the steel shaft is fastened a 10-ft. length of fine silk thread, by means of which the straw needle can be brought at any point along the energized insulator chain. The electrostatic field will make the straw always assume a position in line with the field at any given point. An optical method that is at once simple, safe and ingenious is employed to record the various positions of the straw needle. At one side of the live chain is placed a strong arc lamp, which forms a silhouette of the chain and the detector on a large paper screen on the other side of the chain, where an attendant can trace with pencil the chain itself and the needle positions. The accompanying illustration shows the result. Continuous lines drawn at right angles to the short needle lines give the desired equipotential lines. To determine the quantitative values of the field small Geissler tubes are useful. The tube action is described. — *Elektrotechnische Zeitschrift*, Feb. 26 and March 5, 1925.

Generation, Control, Switching and Protection

Calculation of Transformers. — H. BOHLE. — The method generally employed for the design of transformers consists of two or three preliminary layouts before final data are obtained. This is necessary in order to divide the amount of iron and copper so as best to suit the particular machine. At the same time numerous compromises have to be made between cost, efficiency, heating and inherent reactance. The author develops a new method whereby he claims to arrive at once at the final data, thus saving the time previously required for the trial calculations. With given capacity, ratio, frequency and cost of copper and iron, the author's method arrives quickly at the data for the cheapest transformer for the given conditions. The method, however, appears to have only academic interest, because the all-important reactance of the resulting machine comes out too small. For example, the author gives the design data of a 2,000-kva. transformer and arrives at what is no doubt the cheapest design, but the transformer has a reactance of only about 1.8 per cent, which would be considered today as entirely too low. To make this machine mechanically strong enough to withstand short-circuit forces, so much more construction material would have to be included as to upset the saving originally intended. It is explained that the coil of circular shape is considered today as the safest type for power transformers, on account of easier and more reliable winding, better resistance against distortional forces and better potential distribution under high-frequency stresses.—*Elektrotechnische Zeitschrift*, Feb. 26, 1925.

Parallel Running of Alternators.—JULIUS FRITH and F. BUCKINGHAM.—Starting with the equation that gives the frequency of an angular vibration in terms of the moment of inertia and the restoring torque per radian of displacement, the quantities that enter into the hunting action are discussed. They involve, necessarily, the prime mover as well as the alternator. The effect of damping windings can be computed from the full-load slip, imagining the machine to be run as an induction motor. The synchronizing torque is obtainable from the angular displacement of the rotor due to load. The results are worked out in rather simple mathematical form, with an illustrative numerical example. A bibliography lists about seventy-five articles.—*Electrician (England)*, Feb. 27 and March 6, 1925.

Units, Measurements and Instruments

A High-Tension Bridge for Measurement of Dielectric Losses in Cables.—R. W. ATKINSON.—Taking the series-resistance capacity bridge of Wien as a starting point, the author traces the stages which led finally to the form that is described in the article. Ignoring the three-conductor cable, one transformer is seen to be supplying potential to the sample C_x and to an air condenser of known capacitance. The

latter is actually insulated with compressed CO_2, has a value of about 100 micro-microfarads and can be used up to 50 kv. root-mean-square voltage. On the right-hand side full testing potential is used; on the left the auxiliary transformer applies about 350 volts. The detecting instrument is an alternating-current galvanometer with its field adjustable as to phase by means of a phase shifter. By using a standard condenser of exactly 10,000 ohms reactance the bridge is made direct-reading in power factor. Consequently the observer can during the progress of a test determine the location of critical points due to temperature, voltage, etc. The device permits measurements on very small samples, the effective length being, in routine work, 3 in. On 6-in. lengths a sensitivity of balance of 0.01 per cent power factor can be obtained.—*Electric Journal*, February, 1925.

Impulse Testing of Transformers.—S. RUMP.—To insure that its power transformers will withstand violent electrical impulses due to waves with steep fronts, such as occur on all transmission lines, a Swiss concern has standardized a routine impulse test for all transformers of more than 3,000 volts. A very simple circuit containing neither inductance nor condensers has been devised for this purpose. A small spark gap, operating immediately in front of a compressed air nozzle, furnishes the required impulse voltage, proof of which is given in an oscillogram. A non-inductive water resistance is the second accessory to the equipment. The impulse potential can be derived from a testing generator directly, or this generator may feed one transformer winding, while the other winding supplies its own impulse voltage for the test. The article gives an exact description of the entire testing equipment.—*Brown-Boveri Mitteilungen*, March, 1925.

Illumination

Miniature Edison "Mazda" Lamps.—L. C. PORTER.—More than half of this bulletin is devoted to lamps for automobile service, which are stated to account for 60 per cent of the 174,573,000 miniature lamps sold in 1923. A tabulation of headlight requirements according to the S. A. E. standard of good practice and according to I. E. S. and S. A. E. specifications for legal requirements, curves of pick-up distance for various conditions, diagrams showing the effect of filament position with reference to focus, wiring diagrams for stop and direction signals, curves of braking distances at various speeds and tables of dimensions of lamps are among the items on which information is given. Other lamps described are those for dental and surgical instruments and for projection service.—*Bulletin L. D. 113A, Lighting Data, Edison Lamp Works.*

Glare and Visibility.—M. LUCKIESH. and L. L. HOLLADAY.—An abstract of this paper may be found in the ELECTRICAL WORLD report of the annual convention of the Illuminating Engineering Society, November 8, 1925. The matter is considered under seven different aspects, such as veiling glare, dazzle glare and irradiation, and the results of numerous quantitative tests are summarized in the form of charts and empirical equations. Under veiling glare, for example, it is shown that clearness of vision is a function of the visibility factor, i.e., the ratio between the brightness of the background and the difference in brightness between background and test object. With vision a maximum when this factor is unity, it is practically unimpaired at 3.5, appreciably impaired at 6.1, while the factor 85 represents the limit of visibility. Further, at the limit, the factor increases with the visual angle of the test object. This has a direct bearing on the visibility of objects in a show window that reflects light from extraneous sources. In a similar way the conditions for blinding glare, for the "shock" of sudden exposure of a light source and other phases of the subject are examined.—*Transactions of the I. E. S.*, March, 1925.

Electrophysics, Electrochemistry and Batteries

Insulation Failure.—W. D. OWEN.—The author points out the complexity of the insulation problem, due to the number of independent variables that may operate to produce failure. Taking up the voltage-time characteristic he shows by specific examples how the voltage that a sample will withstand indefinitely is likely to be overestimated when determined from short-time breakdown tests at various voltages plotted against time. If plotted, instead, against $T^{-\frac{1}{4}}$ the graph becomes a straight line that cuts the vertical axis at $T = \infty$ and thus shows directly the ultimate breakdown voltage. As to other variables, tables are given showing the reduction of dielectric strength with increasing frequency—e.g., to 0.73 at 500 cycles compared with unity at 60 cycles—the seemingly erratic effect on sundry materials of increasing the temperature in air and the marked reduction in their dielectric strength when heated in oil. The customary one-minute test on finished apparatus does not give the information sought and leads to a false sense of security. The writer also objects to routine pressure tests as more likely to cause failure than to give protection.—*Electrician (England)*, Feb. 20, 1925.

Cadmium in the Electrical Industry.—N. F. BUDGEN.—This metal has several interesting and important applications in the electrical industry which the article outlines. An alkaline storage cell with cadmium and nickel electrodes will have a promising field if the price of cadmium can be reduced. The metal now finds use in one form of standard primary cell in the manufacture of tungsten filaments, test electrodes for lead cells, the oxide as an electric furnace resistor of high tensile strength, low negative temperature coefficient of resistivity and low specific resistivity, and the vapor in an arc lamp giving an intense monochromatic red light. Copper alloyed with it possesses the beneficial properties of many special brasses and bronzes, with nearly the conductivity of hard-drawn copper.—*Electrician (England)*, March 6, 1925.

Traction

Virginia Railway Electrification.—HOMER K. SMITH.—Recent increases in terminal facilities necessitate an increase in the carrying capacity of the mountain section of this road which is to be met by electrification. The scheme adopted is similar to that of the Norfolk & Western, with single-phase, 25-cycle power at 11,000 volts or 22,000 volts, supplied through a phase converter on the locomotive to two three-phase induction motors, each driving, through a jack shaft and side rods, two driving axles. Three cabs or units will be semi-permanently coupled together into one locomotive, which will have a continuous tractive effort of 135,000 lb. with motor connections for 14 m.p.h. and a momentary maximum of 277,000 lb.—*Railway Review*, Feb. 21, 1925.

Austrian Express Locomotive.—R. LORENZ.—For regular service on its main electrified lines, the Austrian government has placed an order for four special express locomotives, which are designed as 1-A-A-A-A-1 type. The engines can pull a 500-ton train at 25 miles per hour up a grade of 12 per mile or can reach a maximum speed of 59 miles per hour on the level. An unusual part of the locomotives is four vertical motors, driving the four shafts over pairs of resilient bevel gears. The total output of these four motors is about 2,000 hp. at one-hour rating, developing a pull of up to 9,000 kg. measured on the wheel circumference. The engine is absolutely symmetrically built. Two motors are permanently connected in series. The electric control is accomplished by pneumatic contactors with electrically operated air valves. A very quiet operation is expected from the bevel drive.—*Elektrotechnische Zeitschrift*, March 12, 1925.

Telegraphy, Telephony, Radio and Signals

Long-Distance Wireless Transmission.—G. W. O. HOWE.—This is a criticism of the views of Baeumler as expressed in an article in the February number of the *Proceedings* of the Institute of Radio Engineers. The discussion centers around the conclusion, drawn from a series of transatlantic experiments, that night transmission is normal and that the feebler values found during the daytime are due to absorption. The point of the criticism is that the "theoretical value," with which the night results were found to be in essential agreement, is computed from the formula for absorptionless transmission along a perfectly conducting plane earth, with a correction factor that takes into account the shorter distance along the chord than over the surface of the sphere. This is held to be unreasonable. The writer also comments on the fact that although the measured field strengths are five or six times as great as the values calculated by the Austin-Cohen formula they are in approximate agreement with those by the Fuller formula, which differs by having an exponential factor $\epsilon^{-0.0045d/\lambda^{1.4}}$ whereas the Austin-Cohen factor is $\epsilon^{-0.0015d/\lambda}$.—*Electrician (England)*, March 13, 1925.

News of the Industry

More Details of Feather River Power Plant

Lars Jorgensen, chief engineer of the Feather River Power Company, has made a statement to the following effect regarding the company's sixty-million-dollar hydro-electric development program for Butte County, Cal., referred to in the ELECTRICAL WORLD for April 18, page 833:

In addition to the proposed plant at Buck's Creek, work on which will be started soon, the program includes three major and three minor projects. One major plant will be built above Bald Rock Canyon and will produce a minimum of 69,200 hp. Another major project will be the Bean Creek plant, which will be a short distance below the junction of Bean Creek and the Middle Fork of the Feather River. It will have a minimum of 62,000 hp. The third major plant will be at Sherman Bar and will have a minimum of 47,000 hp. The cost of the major plants will be: Plant above Bald Rock Canyon, $12,707,000; Bean Creek plant, $11,600,000; Sherman Bar plant, $13,190,000. These amounts include cost of water storage.

Of the minor projects, the plant to be built below Bidwell Bar will be the most important. It will have a minimum of 21,500 hp. The Feather River Power Company plans to build at least five reservoirs in addition to the one at Buck's Creek. Their locations and their capacities in acre-feet follow: Grizzly Valley, 92,000; Clio, 130,000; Gold Lake, 19,000; Nelson Point, 115,000; above Bidwell Bar, 96,000.

New York's Attorney-General Takes State's Rights Stand

Former Secretary of State Charles E. Hughes has been retained as counsel to protect New York State's water-power rights against encroachment by the federal government. In making this announcement Attorney-General Albert Ottinger said that the value of the present and potential power developments in New York State in terms of dollars is inestimable, pointing especially to potential developments of 300,000 hp. at Niagara and 1,500,000 hp. at the Long Sault Rapids in the St. Lawrence. "The scope of the question involved is far greater than the contention of the State of New York," said the Attorney-General. "The issue presents timely opportunity to fight for the preservation of state's rights as against the steady encroachment and centralization of power in the federal government—a contest which will enlist the united sympathy of all of the states."

The contest between New York State and the Federal Power Commission, begun under the administration of Governor Miller, was carried on for a while when a Democratic administration took control in 1923, but the suit brought in the United States Supreme Court by the state to declare the federal water-power act unconstitutional was eventually allowed to lapse. Apparently the present state government, which is Republican with the exception of the Governor, means to be prepared for a renewal of effort on this or similar lines.

Southern Sierras Power Asks Court for Higher Rates

The Southern Sierras Power Company, operating in five counties of southern California, has filed suit against the Railroad Commission in the United States District Court of Los Angeles to have the commission's valuation of the utility's property for rate-making purposes set aside. The company asks for a rate increase of approximately 10 per cent, claiming that the valuation of its properties made by the commission in 1920 is so low as to result in confiscation. The court is asked to enjoin the Railroad Commission from enforcing the rates which are now in effect and for an injunction to prevent interference by the commission with a totally new schedule of higher rates which the company proposes to charge in lieu of the commission's rates in all territory where it is not in competition with the Southern California Edison Company.

In 1920 the commission placed a valuation on the properties of the Southern Sierras Power Company, for rate-making purposes, of $7,618,541. The company now contends that the cost to reproduce the properties at the highest peak prices of 1920 should have been used and claims that the value was not less than $10,961,559.

Progress in Conowingo Situation Is Slow

Little progress has so far been made in adjusting the complications surrounding the proposed Conowingo development in Maryland which prevent the Susquehanna Power Company from obtaining a license and letting contracts. Engineers from the Pennsylvania Public Service Commission, the Philadelphia Electric Company and the Philadelphia Rapid Transit Company, chief opponent of the project, have visited the site to check the engineering data, and engineers of the Maryland Public Service Commission and the Federal Power Commission were invited to confer with them. Costs of the development previous to expenditures for actual construction will be determined by accountants of the three commissions concerned. An investigation of the costs prior to 1910 will be undertaken by the accountants of the state commissions and submitted to accountants of the federal commission for approval and co-ordination. No further joint meeting of the commissions themselves has yet taken place.

West Virginia May Set Up Water Power Commission

The West Virginia State Legislature has adopted a resolution creating a water power commission which is to investigate water power in the state, draft a bill and report back at a special session of the Legislature to be called by the Governor. This resolution, which originated in the House and was passed in the Senate by a vote of twenty-one to three, provides for a commission made up of Governor Gore, the president of the Senate, the chairman of the Senate judiciary committee, the Democratic leader in the Senate, the Speaker of the House, the chairman of the House judiciary committee and the Democratic leader of the House—seven members in all.

The resolution as originally passed by the Senate provided for a commission of four, of which the Governor was to be chairman and which would have included a member from the House, a member from the Senate and an engineer, all to be named by the Governor. The measure now approved by both houses and before Governor Gore for his action deprives the executive of the power to name the commission.

Mississippi Power Takes Over Meridian and Other Plants

The purchase by the Southeastern Power & Light Company of the Meridian (Miss.) Light & Railway Company and the Hattiesburg (Miss.) Traction Company has been confirmed. Both these companies control the electric light and power business in the cities named, the Meridian company having owned all the capital stock of the Hattiesburg utility. The sellers were Henry L. Doherty & Company, who have previously disposed of other isolated properties owned by them in Southern states. The purchase was made on behalf of the Mississippi Power Company, a subsidiary of the Alabama Power Company, for which the Southeastern Power & Light is the new holding corporation.

Since the advent of the Mississippi Power Company into Mississippi plants have been acquired in nineteen cities. Operation by local steam power will be superseded by hydro-electricity received from Alabama over high-tension lines which are being rapidly built.

The cities whose electric plants have been acquired, besides Meridian and Hattiesburg, are Laurel, Starkville, McComb, Columbia, Philadelphia, Houston, Petal, Ellisville, Magnolia, Summit and the coast cities of Waveland, Bay St. Louis, Pass Christian, Long Beach, Gulfport, Biloxi and Ocean Springs. Headquarters are at Gulfport.

In Meridian and Hattiesburg the company acquired electric light and power, gas and street-railway plants. In

Laurel the purchase embraced electric light and power and railway properties. Ice plants were included in Columbia and Bay St. Louis. The purchase of the Gulfport & Mississippi Coast Traction Company, which formerly owned the plants in Gulfport, Biloxi and Pass Christian, was also broadly inclusive, absorbing light and power stations and city and suburban railway lines.

War Department Waits on Shoals Board

Asks Recommendations Before Inviting Bids for Lease of Power—Students of Nitrogen Fixation Problem Advocate Free Energy for Experiment

BEFORE advertising for bids for the temporary use of Muscle Shoals power, the War Department has referred the proposition to the Muscle Shoals Commission for a recommendation. In doing so the Acting Secretary of War has called to the attention of the commission the fact that the coming summer and fall is likely to be a period of unusually low water. He also points out that careful and extensive tests of machinery and equipment must be made before the War Department can accept this property from the manufacturers. These tests must be made under load. The wisdom of having leased the steam plant is apparent, since it has brought in nearly half a million dollars in revenue. Had it not been leased during the past three and one-half years it would have called for considerable expenditures for maintenance.

There is no thought of making a firm contract for any power from Wilson Dam. The lease will be revocable at the will of the War Department. Another condition provides for the automatic termination of the lease if Congress should take action which conflicts with such use of the power. In no case is the proposed lease to extend beyond December 31, 1926. The lessee of the power also is required to sell as much as 25,000 hp. to the lessee of the nitrate plant. The sale is to be made at cost plus 10 per cent. One of the questions put to the commission is whether or not the War Department should issue "a revocable lease of the steam-power plant combined with the sale of power from the first hydro-electric unit, with the idea of making power available for the partial operation of plant No. 2," or merely sell the surplus power under a revocable contract only.

The Muscle Shoals Commission also has been asked by the War Department whether it is practicable to lease nitrate plant No. 2 for partial operation. Although it is hard to understand how any one could undertake the fixation of nitrogen on a month-to-month basis, it is the announced intention of the Union Carbide Company to bid for the power and the use of the nitrate plant.

The War Department will insist that the power be leased to one bidder. For several months variable amounts of power will be available. If there is more than one bidder, there would be difficulty in deciding which one should be deprived of power when the full output is not being delivered.

ADVOCATE FIXATION LABORATORY

It is believed by some who have studied the matter closely that power at Muscle Shoals should be made available without charge for the use of those who are developing promising processes of nitrogen fixation. There are half a dozen processes under development in the laboratories of the world. The government, according to this plan, would furnish a site and the necessary power to inventors to help demonstrate what can be done with their processes when operated on a commercial scale. Free power would be furnished for five years. After that time the concerns would be required to buy their own power. This would carry with it, however, rights to continue thereafter the use of the plant and assurances of ample power at reasonable rates. The thought is that any process with commercial possibilities would be self-supporting after five years and able to pay for its power.

No provision for the limitation of profits is believed necessary. If any one develops a process that can produce nitrogen cheaper than the natural product can be laid down in our markets, operations will spring up elsewhere than at Muscle Shoals and competition will insure reasonable prices. Limitation of the profits of such an enterprise by legislative enactment is held to be the conception of the demagogue.

Advocates of the plan described oppose a great government experimental plant. This latter plan, calling for $5,000,000, would mean that a man willing to work for $7,500, all the salary Congress would probably approve, would select the process and conduct the experiments under all the limitations and handicaps which surround a politically chosen administrator.

Letters to a large number of persons having special knowledge of the possibilities of Muscle Shoals and to others who are interested in public affairs generally were mailed April 22 by the commission. It is expected that a meeting of the commission will be held during the week of May 4, at which time it probably will agree upon the answer which is to be made to the Secretary of War in the matter of the temporary disposition of the power.

Cause of Accident to Detroit Edison's New Dam

Further details of the partial washing out of the Detroit Edison Company's new dam on the Huron River, referred to last week on page 834, received from Chief Engineer J. W. Parker of that company, are to the effect that from 100 ft. to 150 ft. of the earth embankment forming part of the dam gave way, the trouble starting when a small hole was cut through by water about 8 ft. below the completed pond level. The concrete portion of the dam and the power plant proper were not hurt. The opening of the plant, however, contrary to last week's report, is likely to be delayed for two or three months.

Gardner S. Williams of Ann Arbor, the consulting engineer under whose direction the dam was built, says that the failure is to be charged to the misjudgment of the foundation, an alluvial deposit underlaid by a bed of blue clay. There may possibly have been a limited stratum of more fluid material whose presence was not discovered by the borings. The masonry was carried to and into the clay, but in the case of the embankment this was considered unnecessary. Frost coming out of the ground while the pond was rising obscured any evidence of seepage, this probably preventing the discovery of the leak in time to prevent the accident.

Insull Tells "Public Utility Facts for Bond Men"

Speaking on the subject "Public Utility Facts for Bond Men" before the Pittsburgh Bond Club at Pittsburgh on April 17, Samuel Insull, president Commonwealth Edison Company, dealt with the history of municipal ownership agitation, asserting that "municipal or government ownership proposals drew little or no attention until after private initiative had made public utility enterprises a success, and not until a certain type of mind, functioning in politics, saw in their success an opportunity to capitalize envy."

The speaker gave some significant figures concerning the growth of utilities, and particularly electric light and power companies, showing how they have weathered war and post-war handicaps. Only nine electric light and power companies failed in 1921, when the war-period boom receded, he said, as against 495 manufacturing enterprises, forty-five national banks and fifteen savings banks, and the total liabilities of the central-station companies were only $302,000.

Referring to the political agitation over "superpower," Mr. Insull said: "The electric light and power industry was working on these lines—as it is still working—and had made much progress long before 'superpower' was ever heard of by the political gentlemen who now propose various more or less fantastic schemes for achieving it. The industry is more concerned than they ever can be to effect all possible efficiencies and economies and to increase the opportunities for using electrical energy. We have developed the industry by doing exactly that. The problems of 'superpower' or 'giant power' development, including hydro-electric development, are financial and economic as well as technical. The industry may be depended upon to work out the problems as soon as, and wherever, it becomes economically and technically practicable."

After defending the holding companies along the same lines as in his Louisville address, reported at length in the ELECTRICAL WORLD for April 11, page 782, Mr. Insull concluded with a note of warning against permitting the speculative element to enter into the sale of securities. Investors and op-

erators, he said, "should bear in mind that this is necessarily a regulated business; that if profits grow excessive rates will be, or should be, reduced by the proper regulating authorities; that there is no room in the business for the issuing of stocks and bonds except for fair value, and that mere combinations to obtain a showing of big gross income are not necessarily combinations which will yield increased return to the investors."

Ohio Commission Nominees Not Confirmed

Despite Governor Victor Donahey's radio speech, in which he assailed the State Senate for its failure to confirm his two appointees to the Public Utilities Commission of Ohio, the Senate at its final session refused confirmation. The vote on Earl D. Bloom, former presiding officer of the Ohio Senate, was eighteen to seventeen against his being confirmed as a member of the commission. He had been named by the Governor to succeed Charles C. Marshall, whose term expired two years ago. On the nomination of James Huffman, the governor's executive secretary, who had been named to succeed George T. Poor on the commission, the vote was nineteen to thirteen with three senators not voting. Mr. Poor's term expired February 1 of this year.

What further steps the Governor will take, if any, are not known. Since the adjournment of the Legislature he has made no statement on the situation. In a radio address broadcasted throughout Ohio the Governor, as noted in last week's ELECTRICAL WORLD, had declared that the Senate, overwhelmingly Republican while he is a Democrat, was playing party politics in refusing confirmation of his appointees to the commission. He also charged in that address that the American Gas & Electric Company and the telephone interests were trying to block confirmation.

Fishing Interests Denounce Priest Rapids License

Declaring that the salmon-fishing interest on the Columbia River has been "double-crossed" owing to the issuance by the Federal Power Commission of a license for a dam at Priest Rapids, to be built by the Washington Irrigation & Development Company, the *Pacific Fisherman*, published at Seattle, has launched an attack upon the commission. The periodical asserts that the fishery interests on the Coast derived a false sense of security from representations made by the power company and by United States engineers, understanding that the fishery problem would have to be solved before the dam could be built. It holds that the clause in the license that the company shall construct a "fishway, fish hatchery or such other structure or structures as may be determined by the Secretary of Commerce, and in accordance with plans which shall be prescribed or approved by said Secretary," does not meet the case, because of its provision that "the financial responsibility herein imposed on the licensee for the construction of such structure or structures shall not exceed an aggregate of three hundred thousand dollars."

This proviso, the periodical maintains, "has sold out the rights of the fishing industry on the Columbia River for $300,000," since the power company's liability is limited to that sum, and it quotes a letter written by Secretary Hoover to the Federal Power Commission under date of March 7 in which he refuses to accept responsibility for working out such a system as is called for and says responsibility "should be placed primarily and absolutely upon the licensee itself," expressing also the belief that $300,000 will probably prove insufficient for that purpose. The Secretary also calls attention to the right of the States of Oregon and Washington to be consulted.

Southwest N. E. L. A. Meets

Geographic Division and Arkansas Utilities Association Assemble at Hot Springs

PUBLIC relations were once more brought to the fore as embracing the most important problem now before the electric light and power industry in the presidential address of J. F. Owens before the fifth annual convention of the Southwestern Geographic Division of the National Electric Light Association, which met from Tuesday to Friday of this week jointly with the Arkansas Utilities Association, at the Eastman Hotel, in Hot Springs, Ark. Mr. Owens, who is president of the Oklahoma Gas & Electric Company, reviewed some of the accomplishments in the Southwestern territory in the past year.

Franklin T. Griffith, president of the national association, made an address on Wednesday on the value inuring to the public from the private ownership of central-station plants. Other addresses were made during the convention by J. L. Longino, president of the Arkansas Utilities Association; Hartwell Jalonick, president Jalonick Appliance Company of Dallas, on "Central-Station Merchandising"; B. J. Mullaney, vice-president People's Gas & Light Company, Chicago, on "Employees' Relations"; W. H. Hodge, director of publicity H. M. Byllesby & Company, on "Public Utility Advertising"; W. H. Onken, Jr., editor ELECTRICAL WORLD, on "Outlook for the Electrical Industry"; M. H. Aylesworth, managing director N. E. L. A., on "The Industry"; C. F. Hirshfeld, Detroit Edison Company, on "The Technical Section—Its Part in the Development of the Industry"; E. A. White on "Electric Service for the Farm"; H. L. Nichols, Chicago, on "Financing the Public Utility"; Harry C. Spillman, New York, on "Adjusting Ourselves to a New Era in Business," and by Halford Erickson, vice-president Byllesby Engineering & Management Corporation.

The Technical, Public Relations, Commercial and Accounting Sections held separate sessions. Committee reports were thorough and copious, and entertainment was abundant. The banquet on Thursday evening was addressed by George B. Rose, attorney of Little Rock.

Action Against Hodenpyl-Hardy Companies in Ohio

Hodenpyl, Hardy & Company, the Northern Ohio Power Company, Northern Ohio Electric Corporation, Northern Ohio Traction & Light Company and the Bankers' Trust Company have been made defendants in an action which seeks to compel the return of $3,658,931 to the treasury of the Northern Ohio Traction & Light Company of Akron and to restrain any further dividend payments on its common stock.

The petition charges that Hodenpyl, Hardy & Company organized the Northern Ohio Electric Corporation in order to secure all outstanding common stock of the Northern Ohio Traction & Light, and that through the Electric Corporation they obtained the stock, setting up their own men as N. O. T. & L. directors. A second holding company, the Northern Ohio Power Company, it is charged, was organized by them when the first holding company was unable to meet a loan of $2,500,000 from banks. The suit further alleges that after the Hodenpyl interests got control of the Akron company they made it agree to pay to the Electric Corporation, as compensation for general management and other services, 2 per cent annually on gross income, as well as 3 per cent of the company's construction expenditures as payment for supervising construction work. Dividends also were paid, the plaintiff says, on common stock, when the company should have shown a deficit.

The suit is brought by Walter D. Foss of Wooster, Ohio, a holder of preferred stock.

The charges made are emphatically denied by B. C. Cobb, president of the Northern Ohio Traction & Light Company, who says that the actions complained about have redounded to the benefit of all the stockholders and that common-stock dividends have been paid only out of earnings. Mr. Cobb says the case will be contested to the limit.

Industrial Heat School Meets May 11 to 23

Another opportunity for central-station sales engineers to gain specialized information on the practical applications of industrial electric heating is being offered by the Power Bureau of the National Electric Light Association through its industrial electric heating committee. The course will be conducted at the works of the General Electric Company from May 11 to May 23 and will be the only national electric heating school opened this year.

A program and enrollment blank has just been issued by V. M. F. Tallman, chairman of the power committee, N. E. L. A., who has urged upon all central-station companies the importance of having at least one man in their power department properly trained to recommend and supervise the proper installation of electric heating equipment. Mr. Tallman is anxious that enrollment for this year's school be completed, if possible, by April 25. The course begins at Schenectady, N. Y., and finishes at Pittsfield, Mass.

The only cost to central-station com-

panies sending men to take the course is the living expenses (average perhaps $7 per day) and traveling expenses for two weeks. All desiring to take the course should send enrollment to V. M. F. Tallman, chairman power committee, N. E. L. A., care of Charles H. Tenney & Company, Boston.

St. Lawrence River Program

Engineering Work to Follow Close of Preliminary Negotiations with Canada

DIPLOMATIC correspondence in regard to the proposal for joint action by the United States and Canada for the improvement of the St. Lawrence River between Montreal and Lake Ontario for navigation and the development of water power has just been published simultaneously in both countries. It covers the period from April 28, 1924, to March 17, 1925. Under the last date, in a letter from Secretary of State Kellogg to the British Ambassador, the instructions to the joint board of engineers, as arrived at, are included. In these instructions the new board is charged with reporting on the scheme presented by its predecessor in 1921, on alternative schemes, on cost estimates for navigation and power and for either alone, on water levels, on the time necessary to complete the proposed works and the order in which they should be undertaken, and on a number of other points.

ENGINEERING WORK TO START AT ONCE

After the publication of this correspondence and the instructions adopted, Secretary of Commerce Hoover issued a statement in which he said that the engineering work will start at once, Congress having appropriated $275,000 for the purpose and the Canadian government having made the necessary appropriations. Besides this investigation, the Secretary said, there will also be another, directed by Congress and covered by special appropriations, of the projected deep waterway from the Great Lakes to the Hudson River, to determine its feasibility, cost and operating expenses. These two investigations should be completed within approximately twelve months, and it will then be possible to determine finally national policies and to proceed with active steps in realization of the lakes-to-sea connection. Parallel with the engineering investigation, an exhaustive survey of the economic aspects of these outlets from the Great Lakes, the value of the development of electrical power from the St. Lawrence canal and other questions will be continued by the Department of Commerce.

Negotiations over the St. Lawrence have on the American side been carried out by the State Department under the general direction of the St. Lawrence Commission, which includes Secretary of Commerce Hoover, chairman; William C. Breed, New York City; James P. Goodrich, Winchester, Ind.; James E. Davidson, Bay City, Mich.; Charles L. Allen, Worcester, Mass.; James R. Howard, Chicago, Ill.; James D. Noonan, Washington; Stephen B. Davis, Washington, and Charles P. Craig, Duluth, Minn. The engineering work will be undertaken for both governments by a joint board of six engineers of whom the American representatives are: Brigadier-General Edwin Jadwin, assistant chief of engineers; Colonel William Kelly, chief engineer Federal Power Commission, and Lieut. Col. G. P. Pillsbury, all of the Corps of Engineers, U. S. A. The Canadian members are Duncan W. McLachlan, Department of Railways and Canals; Oliver P. LeFebvre, chief engineer of the Quebec Streams Commission, and Brigadier-General Charles Hamilton Mitchell of Toronto. The engineering investigation into the Great Lakes-Hudson River waterway project will be conducted by Colonel Herbert Deakyne, Colonel Spencer Crosby and Major P. S. Reinecke.

International St. Lawrence Engineering Board Meets

A meeting of the enlarged joint engineering board which is engaged on a further examination of the St. Lawrence deep waterway and power project was held in Ottawa, Canada, April 15 for the purpose of organizing the work of the board. A comprehensive program of boring and surveying in connection with the international section of the river is being arranged, and the work is being allocated between the American and Canadian staffs. On account of the pressing demand for power and its rapidly increasing consumption in Canada, early attention will be directed to the investigation of schemes looking to the possible development of power in the purely Canadian section of the river.

Allegations of Wrong Use of Barge Canal Water

Four specific instances where surplus waters of the Barge Canal are alleged to be used for power purposes without adequate return to the state were cited in a brief filed with the Water Power Commission this week by Colonel Frederick Stuart Greene, Superintendent of Public Works. The points specified are: Medina, Orleans County, double use of water by S. A. Cook & Company and Western New York Utilities Company; Rochester, inadequate return from Rochester Gas & Electric Company for volume of water used; Fulton, Oswego County, investigation of temporary war permit granted Fulton Light, Heat & Power Company recommended; Northumberland, Saratoga County, review of revocable permit of Iroquois Pulp & Paper Company to determine if return received by state is adequate suggested.

Southern Water Power Projects Seek Authority

The Roanoke-Staunton River Power Company has applied to the Federal Power Commission for a preliminary permit covering a project on the Roanoke River, Virginia. It is planned to build three dams in the Lynville Ford area of the river and two dams in the Anthony's Ford area. The improvement will involve about 60 miles of the stream. No data have been submitted as yet as to the type of structures to be built or as to the power possibilities of the project.

Wellman Bradford, on behalf of the Louisiana Gravity Canal Company, has applied for a license covering an extensive irrigation and power project on the Calcasieu River and Bayou Cocoderie, in western Louisiana. The applicant held a preliminary permit covering this project for eighteen months and allowed it to elapse six months ago.

Southwestern Public Service Association's Program

For its meeting at the Rice Hotel, Houston, Tex., on May 5-8 the Southwestern Public Service Association has prepared a comprehensive program of addresses, papers and entertainment. There will be general sessions on Tuesday, Wednesday and Friday and sessions of the Electric Service Section on Wednesday, Thursday and Friday. The entertainment includes a 25-mile boat ride on the Houston Ship Canal, when an opportunity for inspecting the Deepwater power plant of the Houston Lighting & Power Company will be afforded; dancing, automobile rides, luncheons and golf.

Among the chief events in the general program are addresses on "Fundamentals of Good-Will Building" by Keith Clevenger, Empire Companies, Bartlesville, Okla.; "Continuing Relations with Customer-Owners" by S. J. Ballinger, San Antonio Public Service Company, and "Future of National Electric Service" by General Guy E. Tripp, Westinghouse Electric & Manufacturing Company. Following is the program of the Electric Service Section:

WEDNESDAY, MAY 6

Afternoon.—Commercial Division: "Increasing Domestic Consumption," discussion led by George S. Jones, Jr., Dallas; "Merchandise as a Load Builder," discussion led by W. R. Cabaness; "Educating All Employees to Be Salesmen," discussion led by W. E. Clement, New Orleans.

Technical Division: "Obtaining Power Factor with Watt-Hour Meter," H. O. Crouch, Houston; "Modern Furnace Practice—Combined Burning of Oil, Coal and Gas," R. H. Forney, Dallas; "Use of Black Diamond or Creosoted Poles and Bare Copper Wire in Local Distribution," J. S. Roth, Corsicana.

THURSDAY, MAY 7

Morning.—Commercial Division: "Domestic Refrigeration," Harry Seaber; "Commercial Refrigeration" (discussion leader to be selected); round-table discussion on commercial problems.

Technical Division: "Value of Periodical Transformer Inspections and Tests," E. T. Keck, Dallas; "Most Economical Unit to Be Used in Standby Plants," E. R. Hoppe, Abilene; "Underground-Network Distribution System," F. G. Frost, New Orleans.

Small-Plant Division: "Aims of the Small-Plant Division," B. F. Cherry, Weatherford; "Training and Holding Employees," discussion led by Paul Freeman, Navasota, and W. A. Darter, Giddings; "Building and Keeping Good Relations with Customers and City Officials," discussion led by A. W. Stephan, Yoakum, and S. Eastland, Kerrville; "Rates and Valuation," discussion led by D. P. Yoder, Snyder, and M. D. Honaker, Farmersville.

FRIDAY, MAY 8

Morning.—Small-Plant Division: "Financing Small Plants—Capital and Extensions," discussion led by Charles F. Ashcroft, Sulphur Springs, and L. L. Stephenson, San Antonio; "Importance of Schedule for Maintenance," discussion led by R. J. Irvine, Jacksonville, and F. B. Hall, San Saba.

Executive Session: Reports of Accounting Division, E. C. Jolly; Commercial Division, W. R. Cabaness; Technical Division, J. E. Craven, and Small-Plant Division, B. F. Cherry.

Damming Beaver River

Soft Maple Hydro-Electric Project First in East to Use Straight Hydraulic Fill

DAMMING a river by its own force is the task which is being successfully carried on by the Northern New York Utilities, Inc., of Watertown, N. Y., on the Beaver River, 40 miles east of that city. This undertaking, the first straight hydraulic fill ever attempted in the East, is known as the Soft Maple Dam power project.

Remote from any railroad, in the foothills of the Adirondack Mountains, the hydraulic fill was decided upon as the most practical means of construction, and the contracting company set about to harness the stream, so that water from the Beaver River, pumped by electricity generated by the Beaver River, is damming the same river for the generation of further electrical energy. The earth is sluiced direct from the borrow pits, a distance of over a quarter of a mile, to the site of two dams being built.

The smaller of these is being constructed across the Beaver River, about a mile above the outlet of Beaver Meadow Creek. This dam is being built with a concrete-core wall and will require for completion a fill of about 230,000 cu.yd. of earth. At the foot of the valley, near where the small stream flows into the Beaver River, the larger of the two dams is being built. From the bottom of the excavation which was made for the core to the crest of the dam is 150 ft., and the valley at the top of the dam is 800 ft. in width. No core wall is being built here, but a finely selected grade of earth is sluiced in. To do this twelve centrifugal pumps, hitched up in pairs, each pair capable of delivering 3,000 gal. of water a minute against a 360-ft. head, have been set up, each pump driven by a 167-hp. motor.

On the west side of the Beaver Meadow Valley, which enters the Beaver River Valley from the south, a headrace is being constructed with gates, and short penstocks are being built to carry the water to the power house, also under construction. This building will be able to house three 10,000-hp. vertical turbines directly connected to generators. Two of these are to be installed before the plant is opened and the third will be set up when demands for power call for it. The plant will be operated under a working head of 120 ft., and the tailrace will empty into the upper end of the pond of the Effley Falls Dam, another of the company's developments, which has been in operation for some time. On the north side of the Beaver River Dam a spillway is being constructed.

The entire project will cost the Northern New York Utilities approximately $2,250,000. The contract for the construction work was awarded the U. G. I. Contracting Company on May 6, 1924, while the contract for the two turbines to be installed was let to William Cramp & Sons Ship & Engine Builders of Philadelphia.

Wisconsin Association's Plan Succeeds

Short General Session Rounds Off Year's Sectional Meetings—Not a Single Utility Rate Case Has Been Taken to Court in Twelve Months, Neff Says

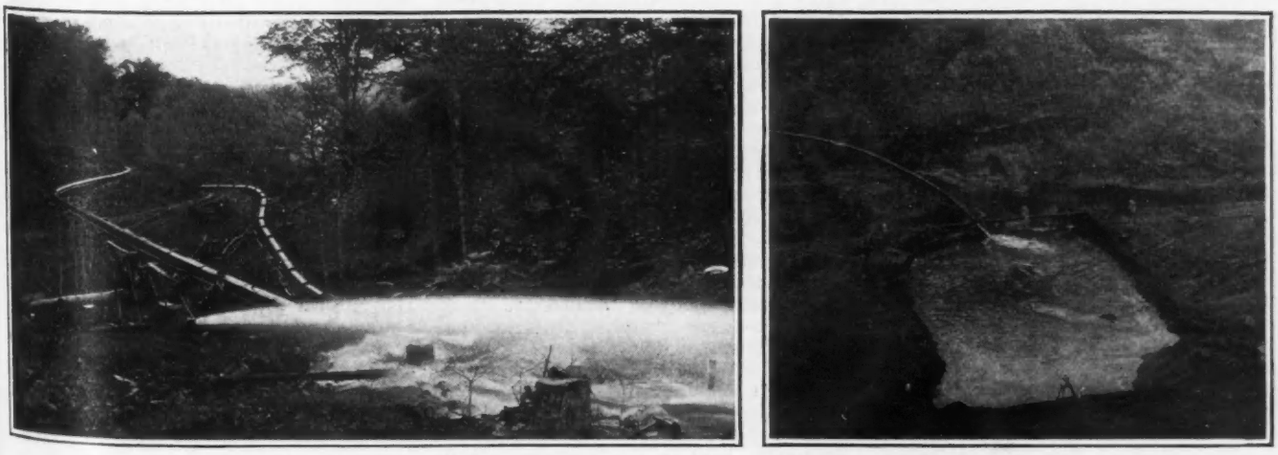
THE Wisconsin Utilities Association in holding a general one-day convention at Milwaukee on April 16, attended by more than 250 executives, brought to a successful conclusion its new policy of holding in different cities separate conventions of the electric, gas, street-railway, accounting and commercial sections and finished off the year's program with a joint convention at which only problems of common interest to all sections were discussed.

President G. C. Neff, in opening the convention, said: "Utilities are not piling up dividends and giving only such service as they can 'get by with.' Instead they are providing their services more efficiently each year and the savings made by these increased efficiencies are passed on to their customers. Not a single public utility company during the year has carried a case into court to substantiate claims for higher rates. Undoubtedly in many cases higher rates could have been substantiated in view of the numerous decisions of the Supreme Court allowing utility values based upon reproduction costs, but even though the Wisconsin Railroad Commission has not taken reproduction costs into as great consideration as laid down by the Supreme Court of the United States, the utilities have not appealed from the findings of the commission but have manifested a desire to co-operate and let better understanding develop."

Lewis E. Gettle, chairman of the Wisconsin Railroad Commission, speaking on the subject of "Some Legal Phases of Regulation," said that recent court decisions have hampered and limited the commission in its effort to compel municipally owned companies and mutually owned companies to provide service to any one demanding it. Bills have been introduced in the Legislature now in session to eliminate these limitations of jurisdiction over mutual nonprofit organizations and municipally owned utilities so that persons who have not invested money in such mutual organizations and people residing outside the limits of a municipality shall not be barred from procuring service.

T. D. Crocker, assistant vice-president of the Northern States Power Company, Minneapolis, in talking on the "Sources of Good Relations with the Public," outlined a definite plan whereby the entire personnel of a company can be systematically enlisted in a family effort to earn and deserve public good will. "Public relations," said Mr. Crocker, "will always be the most important subject of utility management. Utilities must be humanized. General officers must be more than merely managers of companies; they must participate in community life. Every company must be eternally vigilant in winning public approval."

Dean Ralph E. Heilman, School of Commerce, Northwestern University, Chicago, whose subject was "Relationship of Education and Research to Public Utilities," said that there is a distinct movement throughout the country t make education in public utility operation and management an integral part of university courses. Wisconsin, Illinois, Pennsylvania, New York, Indiana, Harvard and Northwestern universities have introduced complete courses in utility training in their curricula. "Research work in public utilities will undoubtedly result," he said, "in a great increase in literature



EARLY STAGES OF SLUICING FOR SOFT MAPLE DAM ON BEAVER RIVER, N. Y.

on public utilities—literature that is impartial and presents the facts. The economic phases of research into public utility practice constitute the most fruitful field universities have ever attempted."

Speaking on the subject of "Development in Public Utility Financing," George E. Frazer of Chicago observed that the owners and managers of public utilities have become in every sense real partners of the public and the most interesting recent development in public utility affairs lies in the great increase in the number of small investors who are buying public utility stocks and bonds. "While the greatest development," he said, "in the sale of stocks to consumers and to employees has taken place in the case of those utilities which are owned and operated by large holding companies, there is no reason why the small companies should not be as successful in interesting the public in their securities."

Miss Lillian Minch, Madison, chairman of the women's public information committee, said that forty-one companies in Wisconsin have organized their woman employees and have held at least four meetings each in an effort to familiarize them with the fundamentals of the operation of the utility business so that they could give accurate information to the public concerning utility services. She urged executives to teach their women employees to become speakers before women's clubs throughout the state.

The convention closed with a banquet, at which Harry F. Atwood, Chicago, spoke on the federal constitution.

ELECTION OF OFFICERS

George H. Wilmarth, Eau Claire, Wisconsin manager of the Northern States Power Company, was unanimously elected president of the association. William C. Butterworth, manager Platteville Gas Company, Platteville, was elected vice-president. Harrison A. Smith, Madison, Southern Counties Power Company, was re-elected treasurer and J. N. Cadby was reappointed executive secretary. John St. John, Madison, vice-president and general manager of the Madison Gas & Electric Company, was made chairman of the newly created Public Relations Section, and G. W. Van Derzee, assistant general manager of the Milwaukee Electric Railway & Light Company, was elected vice-chairman.

A. E. S. C. Appoints Advisory Committee of Executives

The American Engineering Standards Committee announces the formation of a committee of five first-line executives, to act as an advisory body to the committee in standardization efforts, particularly as these affect the elimination of waste. This advisory committee will consist of J. A. Farrell, president of the United States Steel Corporation; G. B. Cortelyou, president of the Consolidated Gas Company, New York; J. W. Lieb, vice-president of the New York Edison Company; L. F. Loree, president of the Delaware & Hudson Company, and Gerard Swope, president of the General Electric Company. The committee will emphasize what is regarded as the fundamental principle of standardization—that it must facilitate and stimulate, and not hinder, industry.

The committee will assist in keeping executives in touch with the national movement in its development, in extending its influence and support both intensively and extensively among industrial groups, and in bringing about the fullest co-operation along right lines between industry and government in standardization work, and particularly in the solution of the problem of industrial waste, into which Secretary Hoover has thrown the resources of the Department of Commerce. Hitherto the movement has been largely centered in and carried on by the technical man. The appointment of the committee marks definite recognition of the fact that standardization has now become a managerial problem of the first rank in industrial production.

Initial 60,000-Hp. Grand Falls Plant to Cost Six Millions

According to a report of the Electric Power Commission of the Province of New Brunswick, made public recently, more than a half million dollars' worth of actual construction will be completed on the hydro-electric development at Grand Falls by October 31. The report gives a detailed description of the proposed works. The head dam across the St. John River, the intake, canal, forebay and gatehouse will be completed for a maximum development, and the generating station will at the outset contain two units of 25,000 hp. each.

The transmission lines will comprise 132,000-volt and 55,000-volt ring systems. The first built will be a 132,000-volt line from Grand Falls to Bathurst, Campbellton and Edmundston and a similar line from Grand Falls to Woodstock, Fredericton and St. John, connecting at the last-named city with the present transmission line from Musquash to Moncton. From Fredericton 66,000-volt lines will run to Moncton via Chipman and to St. Stephen via Macadam, while there will be a 132,000-volt line from Fredericton across the province following the line of the Canadian Eastern division of the Canadian National Railways to New Castle. The existing transmission line from that point to Bathurst will link the new lines with the northern district system.

Estimates put the cost of the initial development at $6,000,000, not including the transmission lines. The International Paper Company, owner of shore rights, islands, water frontage and even the actual site upon which the proposed hydro-electric plant will be built, will not place any unnecessary obstacles in its way, but stands ready to facilitate the development in any way possible, while at the same time protecting its own interests. President Graustein of the International Paper Company, in a statement given out at Fredericton, N. B., said that if conditions which are satisfactory can be arranged the company is prepared to carry out an elaborate industrial development scheme for New Brunswick which involves an expenditure of $10,000,000. The carrying out of this scheme, he said would involve the utilization of probably as much as 30,000 hp. of energy from Grand Falls.

Nation-Wide River Survey

Cost Data and Preliminary Information to Be Gathered at Instance of Congress

TO COMPLY with the provisions of the new river and harbor act the Corps of Engineers and the Federal Trade Commission are gathering data as to the cost of a comprehensive survey of the rivers of the country and information which is expected to establish, as never before, the need for such a study. The survey is urgently needed so that power development, navigation improvements and flood control can be carried forward effectively.

There was reason to believe the survey itself would be authorized in this act, but differences of opinion among those most interested in obtaining the legislation prevented that action. The law does provide, however, for a report setting forth the needs for and the expense of such a study. It is known definitely that a very strong report favoring these surveys can be written. While the need has been apparent for a generation, no exhaustive argument supporting such an endeavor ever has been prepared.

General Harry Taylor, the Chief of Engineers, states that his first step in carrying out the mandate of Congress will be to call for a report from each of his district officers which will cover the needs of that particular section. This preliminary report will set forth the data obtainable in the files of each office. When these reports have been examined such additional information as may be needed then will be called for.

The Federal Power Commission will confine its work to material which will bring out clearly the need for a nation-wide survey of rivers and streams. Because of lack of engineering data the Power Commission now is compelled to give rights for fifty years without knowing whether or not the proposed power development will fit into the maximum utilization of the stream's resources or the best plan to aid flood control and navigation.

It is not the object of these proposed surveys to go into such detail or to make so careful an economic study as now is in progress on the Tennessee River. That survey alone will cost in excess of $500,000. Even on a stream with the potentialities for power production of the Tennessee, there is doubt as to wisdom of such a detailed study. The idea now proposed is to get an accurate picture of the whole river. The detail can be worked out later as actual development is undertaken.

Congress already has specified its intention to use license fees and rental receipts for these studies. A simple enabling paragraph is all that is needed to make available $250,000 annually for this work. The report which now is being prepared is expected to be so convincing that little further delay will result in securing the necessary legislation.

Briefer News

Oil and Gas Power Week.—More than 110 meetings in thirty-four states were held during the week just closed in the interest of a more extensive use of oil and gas in the production of power for industrial service, numbered among the participating organizations being the National Electric Light Association.

Water Flows Between San Joaquin Lakes.—Waters of the upper San Joaquin River last week were turned into the 13½-mile tunnel of the Southern California Edison Company which connects Florence and Huntington Lakes, putting into use this great engineering accomplishment, the completion of which was noted a few weeks ago.

Byllesby Company Buys a Wyoming Utility.—John J. O'Brien, president of H. M. Byllesby & Company, announces the purchase of the Natrona Power Company, which supplies the electric light and power requirements of Casper, Wyo. Casper is the center of the Wyoming oil industry and the location of three refineries having a total of 63,000 barrels capacity. It has grown from a population of 2,639 in 1910 to over 32,000 at present. The Natrona Power Company in 1924 had gross earnings of $566,000 and served 6,644 electric customers.

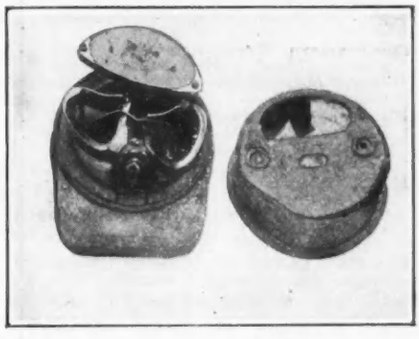
Owners of Rochester Company Take Over Small Plants.—The Mohawk Valley Company of Rochester, N. Y., has been authorized by the Public Service Commission to purchase the entire outstanding capital stock of the Hilton Electric Light & Power Company and the Cooper Electric Company, both of Hilton, Monroe County. The Mohawk Valley Company holds the securities of the Rochester Gas & Electric Corporation, the Mount Morris Illuminating Company and the Mount Morris Water Power Company.

Mexican Governor Seizes Electric Plant Owned by Americans.—Newspaper dispatches report that the Governor of the State of Vera Cruz, in Mexico, has seized the plant of the Jalapa Railroad & Power Company, which is owned by Americans. Labor troubles are said to have caused the manager of the plant to leave for Mexico City, and the Governor then seized it, after twenty-four hours' notice to the American authorities, on the ground that there was no one with whom to negotiate. The American Ambassador has protested to the federal Mexican government against the seizure.

First Automatic Substation in Seattle Is Installed.—The first automatic substation to be installed in Seattle is the Pasadena Place station recently put in service by the Puget Sound Power & Light Company. This station, which serves a district in the eastern part of the city, contains two banks of 1,500-kw. capacity each, one being a spare, and the necessary switching equipment for five 4,000-volt secondary circuits radiating from it. Space is provided in the station for a third bank of 1,500-kw. capacity to be installed when load conditions demand it. Other stations of similar operation and control are contemplated for Seattle by the Puget Sound company.

New York State Mergers Authorized by Commission.—The New York Public Service Commission has issued orders permitting the Niagara, Lockport & Ontario Power Company to merge with itself a number of electric companies in western New York the capital stock of which companies it now owns. The companies are the Olean Electric Light & Power Company, Seneca Transmission Company, Livingston-Niagara Power Company, Caledonia; Western New York Electric Company, Jamestown; Bryant Power Company, Wilson, and Cambria Power Company, Sanborn. The Olean company received authority two weeks ago to purchase and merge the Cuba Electric Company.

Meter Speeded Up by Tornado Will Be Restored to Normal.—A reminder of the tornado which passed through southern Illinois and Indiana on March 18 is revealed by the accompanying photograph. A General Electric type I-14 meter belonging to the Consumers'



Power Company, a subsidiary of the Indiana Power Company, was torn from a house in Princeton by the high wind and later picked up in the condition shown. The sturdy construction of this meter as well as the terrific force with which it must have hit a street or curb is shown by the fact that the left drag magnet has been forced up and through the disk, breaking the left post supporting the register, but damaging the register itself only to a minor extent. The metal cover was dented but not punctured; consequently it can be pounded back into shape. The glass in the register window can be replaced, and the register can be easily repaired. A little work will put the meter in as good a condition as before.

Michigan Cities Vote Down Municipal Expenditures for Electric Systems.—By a vote of more than two to one, Kalamazoo (Mich.) citizens rejected the proposition to extend the municipal lighting plant. The vote was 5,374 against and 2,654 for the extension. The amount to be spent had been left to the future. The question had been before the public for nearly two years. In Dowagiac a candidate for mayor who opposed buying an oil engine and generating energy for municipal lighting won in a three-cornered contest. Dowagiac is supplied from a high-tension system.

Smith Vetoes Bill to Extend Rail Electrification Time Limit.—Governor Smith has vetoed the Thayer bill amending the Public Service Commission law by extending the time limit for electrification of railroads in New York City from January 1, 1926, to January 1, 1929. In vetoing the bill the Governor said: "I am of the opinion that the statute had better stand as it is, and if the railroads can show to the next Legislature that they have made an honest, earnest effort to comply with the law and for any good reason given were unable so to do completely by that date, that would be the time, it seems to me, that relief should be extended, rather than one year ahead of time."

Hydro-Electric Project at Elephant Butte Dam.—During a recent visit to the Southwest Hubert Work, Secretary of the Interior, and Elwood Mead, Commissioner of the United States Reclamation Service, investigated the project of constructing a hydro-electric plant at the Elephant Butte Dam. A delegation of Deming (N. M.) citizens who are interested in seeing the plant built in order to afford electric power for operating the irrigation pumping plants in the Mimbres valley discussed plans with them under which the government would have only to install the turbines, the farmers bonding their land to build the transmission lines.

Hamilton (Ohio) City Council Decides to Build Plant.—The City Council of Hamilton, Ohio, has voted to spend $527,000 for the construction of a new electric light plant. At present the city supplements power from its existing plant with energy purchased from private and commercial concerns. The money for the new plant will come out of a bond issue for $650,000 approved by the voters in February, 1920. The vote to spend the money was five to four. Councilman Paul Cartier declared it was cheaper to buy electricity from private power sources and that for the past thirty years the city's plant had been a liability.

Pennsylvania Railroad to Buy Energy from New Jersey Public Service Corporation.—The Public Service Corporation of New Jersey has closed a contract with the Pennsylvania Railroad to supply it with electrical energy. The deal was closed on a sliding scale, and the amount of power supplied will vary according to the actual needs of the railroad. It is designed to supplement the power the Pennsylvania now generates at its own power plant in Long Island City. The new supply will be used solely for needs on the electrified section between the Pennsylvania station in New York City and the Manhattan Transfer and the Long Island Railroad.

Washington Water Power Company's Long Lake-Stratford Line Cut In.—The 110,000-volt transmission line built by the Washington Water Power Company from the Long Lake power plant to Stratford, 90 miles distant, progress on which has been noted in the ELECTRICAL WORLD, was placed in service two or three weeks ago. This line connects at Stratford with a 20-mile stretch to

Neppel, where it will join the 110,000-volt stretch of 25 miles to Taunton on the Chicago, Milwaukee & St. Paul. The completed line from Long Lake to Taunton is 135 miles long and is intended to duplicate the present power supply of the Milwaukee railroad as well as furnish additional power for the Big Bend and Palouse districts.

Virginia's Experimental Rural Line Is Energized.—Word comes from James A. Waller, Jr., of Richmond, Va., the "project leader," that power has been turned on the experimental rural electric line in Virginia, to which reference was recently made in "Briefer News." This is a 2,300-volt, single-phase line and is 5 miles long. It is about 3 miles northeast of Richmond and has twenty-nine original subscribers. The line was built by the Virginia Railway & Power Company, and the experimental work is being done by the Virginia Committee on the Relation of Electricity to Agriculture under the direction of the department of agricultural engineering, Virginia Polytechnic Institute, Blacksburg, Va. The primary object is to determine the maximum economic consumption of electrical energy on different types of farms.

New Public Utility Legislation in Ohio. — Four bills which have been passed by the Ohio Legislature and signed by Governor Donahey, and which will become laws within ninety days, are of interest to the industry in that state. One makes it a misdemeanor, instead of a felony, to interfere with property of an electric light and power company. Another establishes a penalty for stealing steam heat. A third gives the state Public Utilities Commission jurisdiction over all regulatory provisions in rate contracts in addition to the power that body already has over the rate itself. A fourth defines and clarifies the right of electric light and power companies to the power of eminent domain and specifically gives them this right for piers and towers used in connection with high-tension transmission lines.

O'Neill, Neb., May Get Hydro-Electric Plant. — The erection of a 4,000-hp. hydro-electric plant in the Niobrara River north of O'Neill, Neb., to serve that city is to begin in a few weeks, according to announcement at a mass meeting in O'Neill by W. K. Newcomb of Omaha, chairman of the board, and A. W. Person of Fairmont, chief engineer of the Northern Nebraska Power Company. The plant will cost in excess of $450,000 and will be of a type similar to the Keokuk plant. The power site, which after a long delay was approved by the state on January 29, is on the federal highway between O'Neill and Spencer. The company expects, the officials say, to deliver energy to the switchboard at 2 cents per kilowatt-hour. Contracts have been made with northern Nebraska and South Dakota electric distributing companies to take all of the surplus energy generated. Acceptance of the proposal will mean that the city of O'Neill will have to erect a distributing system or else purchase the one now owned and operated there by the Minnesota Electric Distributing Company.

Projected Electrification on Great Northern.—Ralph Budd, president of the Great Northern Railway Company, has announced that the company will proceed immediately with electrification of its main line through the Cascades, a distance of 30 miles, at a cost of $1,500,000. Plans for the work have been completed, and contract for the electric motors and electric locomotives required will be let soon. It is planned to complete the work within ten months. The electrification will cover the stretch between Skykomish, on the west side of the mountains, and Verne, the first station east of the eastern portal of the road's Cascade tunnel. This stretch includes the tunnel, which is 13,873 ft. long, or more than 2½ miles. Electricity will be obtained from a 6,500-hp. hydro-electric power plant that the company installed in Tumwater Canyon, on the Wenatchee River, some time ago to supply energy for hauling trains through the tunnel with electric motors. The plant will be enlarged to 10,000 hp.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations, with their secretaries, is published in the first issue of each volume. For latest list see ELECTRICAL WORLD, January 3, page 76.]

Southwestern Public Service Association—Rice Hotel, Houston, Tex., May 5-8. E. N. Willis, 403 Slaughter Bldg., Dallas.

American Institute of Electrical Engineers—Swampscott, Mass. (regional), May 7-9; Saratoga, N. Y., June 23-27. F. L. Hutchinson, 33 West 39th St., New York.

Missouri Association of Public Utilities—Joplin, Mo., May 7-9. F. D. Beardslee, 315 North 12th St., St. Louis.

Pacific Division, Electrical Supply Jobbers' Association—Arlington Hotel, Santa Barbara, Cal., May 7-9. Albert H. Elliot, 502 Flatiron Bldg., San Francisco.

American Society of Mechanical Engineers—Milwaukee, May 18-21. C. E. Davies, 29 West 39th St., New York.

Southeastern Water and Light Association—Hotel Patten, Chattanooga, Tenn., May 19-21. W. F. Steiglitz, Columbia, S. C.

Electrical Manufacturers' Club—Hot Springs, Va., May 19-22. S. B. Belden, Jeffrey Manufacturing Co., Columbus, Ohio.

Middle West Division, N. E. L. A.—Hotel Fontenelle, Omaha, Neb., May 20-22. (Conjointly with Nebraska Section.) H. M. Davis, Fraternity Building, Lincoln, Neb.

Georgia Electrical Association—Atlanta, May 21-22. W. W. Barr, Georgia Railway & Power Co., Atlanta.

Electric Power Club—Hot Springs, Va., May 25-28. S. N. Clarkson, B. F. Keith Bldg., Cleveland, Ohio.

Electrical Supply Jobbers' Association—Hot Springs, Va., June 2-5. Franklin Overbagh, 411 S. Clinton St., Chicago.

American Association of Engineers—Orlando, Fla., June 2-5. C. E. Drayer, 63 East Adams Street, Chicago.

Iowa Section, N. E. L. A.—Waterloo, Iowa, June 3-4. H. E. Weeks, 623 Union-Davenport Bldg., Davenport.

National Electrical Credit Association—Atlantic City, June 6-7; Philadelphia, June 8-9. F. P. Vose, Marquette Bldg., Chicago, Ill.

Associated Manufacturers of Electrical Supplies — The Homestead, Hot Springs, Va., June 8-12. F. Nicholas, 30 East 42d St., New York.

Northwest Electric Light and Power Association (Geographic Division N. E. L. A.)—Gasco Bldg., Portland, Ore., June 12. W. A. White, Puget Sound Power & Light Co., Portland.

Pacific Coast Electrical Association (Geographic Division N. E. L. A.)—San Francisco, June 15. S. H. Taylor, 529 Rialto Bldg., San Francisco.

National Electric Light Association—San Francisco, June 15-19. M. H. Aylesworth, 29 West 39th St., New York.

Society for the Promotion of Engineering Education — Union College, Schenectady, N. Y., June 17-20. F. L. Bishop, University of Pittsburgh, Pittsburgh.

National Council Lighting Fixture Manufacturers and National Association of Lighting Equipment Dealers—The Ambassador, Atlantic City, June 17-19. Herman Plaut, 432 E. 23d St., New York.

Montana Power Company's New Plant Goes Into Commission.—Without formal ceremony the million-dollar Mystic Lake plant of the Montana Power Company was put in operation as an integral part of the system recently, and all of eastern Montana served by the company's lines gained a potential addition of 10,000 kw. of electrical energy. When operating at full capacity, the new plant will add a third to the energy now going to Billings and the whole eastern section of the company's system, which heretofore has had to depend solely on power generated at the more remote plants at Great Falls and on the Madison River. The new plant, which is on the Rosebud River, 43 miles south of Columbus, the nearest railroad station, and has a fall of 1,100 ft., is the first of its kind ever built by the Montana Power Company. The initial installation is 2,000 kw. To develop this plant involved the building of a 15-mile highway from the county road, which the company will turn over to Stillwater County without cost. The water is carried nearly two miles from the lake to the plant through a wooden-stave pipe line.

Rural Development in Washington Makes Headway.—At a meeting of the executive committee of the Public Relations Section of the Northwest Electric Light and Power Association held at Seattle recently Mrs. L. A. McArthur was chosen to head the women's public information committee of the association, a committee new to this geographic division. H. J. Gille, sales manager Puget Sound Power & Light Company, reported on the activity of the Washington Committee on the Relation of Electricity to Agriculture, stating that plans are under way for carrying on this summer a survey of farming districts in Washington similar to the survey conducted last year by the Oregon committee in that state. This work will be conducted by Prof. L. J. Smith, head of the department of agricultural engineering, Washington State College, Pullman, beginning in June. The survey will cover widely separated districts embracing all the agricultural industry of the state. The chairman of the executive committee is Edward C. Johnson, dean of the College of Agriculture at Pullman, and its other members are D. L. Huntington, president Washington Water Power Company; A. W. Leonard, president Puget Sound Power & Light Company; Huston McCroskey, rancher, Garfield; H. V. Carpenter, dean of engineering, Washington State College, and Professor Smith.

Men of the Industry

Francis Hodgkinson Recipient of Elliott Cresson Medal

Francis Hodgkinson, chief engineer of the South Philadelphia works of the Westinghouse Electric & Manufacturing Company, to whom was recently awarded the Elliott Cresson gold medal, as was reported in last week's issue of the ELECTRICAL WORLD, has been prominently identified with steam-turbine design and construction work during the past thirty-one years. Mr. Hodgkinson, who was born in England, received his primary education at the Royal Naval School at New Cross, London, finishing in 1882, when he began his apprenticeship, extending over the succeeding three years. In 1885 he joined C. A. Parsons & Company, the world-famous turbine engine company, remaining with this company until 1890, during which time he was engaged in steam-turbine work, first as machinist, later as draftsman and finally as superintendent of field work.

FRANCIS HODGKINSON

After a short connection with a mining company in Peru Mr. Hodgkinson returned to England, rejoining C. A. Parsons & Company as general foreman of erecting and fitting shops. The following year the Westinghouse Machine Company, the original name of the turbine-building section of the Westinghouse Electric & Manufacturing Company, secured the American rights for manufacture of the famous Parsons-type turbines, and in 1896 Mr. Hodgkinson became connected with the Westinghouse Machine Company, taking charge of the engineering and designing of the Parsons-type turbines. This position he still retains and in addition since 1916 has been acting as chief engineer in charge of all the engineering departments of the South Philadelphia works. Nearly all the commercial steam turbines built by this company have been largely originated by him. Mr. Hodgkinson has been a frequent contributor to the technical press.

Arthur L. Linn, formerly vice-president and treasurer of the United Gas & Electric Corporation, has been elected president of the Colonial Gas & Electric Company and the Newport Electric Corporation, Newport, R. I. The Utilities Power & Light Corporation, with offices in Chicago, recently acquired control of both these Rhode Island utilities.

C. J. Edwards, president and manager of the Coast Power Company, Tillamook, Ore., has retired following the purchase of that property by the Mountain States Power Company, Albany, Ore.

George H. Taylor, formerly assistant secretary and assistant treasurer of the Virginia Railway & Power Company, Richmond, was elected a vice-president of the company at the recent annual meeting of the board of directors.

J. E. Jennings, vice-president of the Milliken Brothers Manufacturing Company, Inc., New York, manufacturer of galvanized-steel transmission towers, radio towers, etc., has returned to the city following an absence of some months in the Republic of Colombia, where he has been engaged with the Colombian government in the design of a galvanized-steel tower ropeway for suspended passenger and freight cars.

Sir Thomas Callender to Visit United States

Sir Thomas Octavius Callender, known throughout the electrical industry in Great Britain as "Sir Tom," will soon visit the United States for a short time. He has traveled widely in Europe, North Africa, India and the East. Sir Tom has been associated with the British electrical industry from its very commencement and, especially in regard to high-tension distribution, has been one of the pioneers and leaders. In 1873 he entered his father's office in London, the business then being in connection with the asphalt paving of streets. Experiments carried out by himself and his brothers led to the discovery of the insulating product known as vulcanized bitumen. This product was patented in 1881.

In 1882 a company was formed to manufacture insulated wires and cables and generally develop vulcanized bitumen as an insulator, and during the next few years a large proportion of the early underground mains in London and the provinces were manufactured and laid down by the Callender company. The development of the electrical industry, with the consequent increase in the demand for underground mains, rendered it necessary to reorganize the original business, and in 1898 the present company, Callender's Cable & Construction Company, Ltd., was formed to take over the old Callender company.

SIR THOMAS CALLENDER

Sir Tom is now and has been for many years past the managing director of Callender's Cable & Construction Company, Ltd., and is on the board of a number of subsidiary companies formed by that company. In addition, he is a director of several of the great power companies of Great Britain.

Obituary

Charles Woodward Lamb, advertising counselor for the Milwaukee Electric Railway & Light Company, died April 16 at Milwaukee of diabetes. He was fifty-eight years of age. He entered the service of the Milwaukee company in 1906 as right-of-way agent for the real estate department, was appointed seven years later as publicity agent and several months ago was made advertising counselor.

Robert E. Gorton, manager of the Packard Lamp Division, National Lamp Works of General Electric Company, for the past fifteen years, died April 13, after a brief illness, at his home in Warren, Ohio. Mr. Gorton was one of the pioneers in the incandescent-lamp industry, having entered it in 1894. He started with the lamp business in the capacity of an accountant and in 1899 he became assistant sales manager. In 1910 he was made general manager. Mr. Gorton was fifty-six years of age.

Godfrey C. Isaacs, formerly managing director of the Marconi Wireless interests in Great Britain, died in London April 17 after a few days' illness. Mr. Isaacs was educated at Brussels and Hanover universities and at an early age entered the firm of his father, a fruit and ship broker. Some time after retiring from this firm he became manager of the London Marconi Company, resigning his post last November to obtain long-needed rest.

Asa Martinus Mattice, prominent mechanical engineer, died of pneumonia at the Engineers' Club, New York, April 19, in his seventy-second year. Mr. Mattice was graduated from the United States Naval Academy in 1874 and later was appointed to the teaching staff at Annapolis. In 1889, retiring from the navy, he became associated with E. D. Leavitt of Boston, consulting engineer for the Calumet & Hecla Company. Subsequently he was affiliated with the Westinghouse Electric & Manufacturing Company, the Allis-Chalmers Manufacturing Company and the Walworth Company.

Recent Court Decisions

Commission Cannot Be Enjoined from Performing Its Duties Because of Fear that It May Err.—The Crowell & Spencer Lumber Company obtained a preliminary injunction against the Louisiana Public Service Commission to prevent it from taking jurisdiction of a complaint connected with alleged discrimination by a common carrier. This injunction has been dissolved by the Supreme Court of Louisiana, which holds that the Public Service Commission is a creature of the state constitution, which vested it with all power and authority necessary to carry on its functions, and courts may not stop its officers from performing that statutory duty for fear that they should perform it wrongly. (102 So. 866.)*

Owner of Land Who Refrains from Participation in Condemnation Proceedings Cannot Subsequently Attack Findings.—In reviewing the case of Clark vs. Wisconsin-Minnesota Light & Power Company, the Supreme Court of Wisconsin said that when condemnation proceedings are regularly instituted against property with the knowledge of the owner he must participate in the proceedings or give up the right to attack the judgment. The Wisconsin-Minnesota Light & Power Company in building the Wissota dam in 1917 instituted condemnation proceedings against land which would be overflowed. The plaintiff did not participate and five years later sued to set aside the damages awarded to him, making allegations of fraud for which the court found no basis in the evidence. (202 N. W. 678.)

Supreme Court Declares Compulsory Arbitration Unconstitutional. — That provision of the law of Kansas setting up the Industrial Relations Court which prescribed compulsory arbitration in labor troubles in certain so-called "essential industries" when the public interest demanded it has been declared unconstitutional by the United States Supreme Court in the suit of the Charles Wolff Packing Company against the Kansas court named. The Kansas law was based in part, the Supreme Court said, upon the assumption by the state that the system of compulsory arbitration could be used in compelling owners and employees to continue business on terms not of their making, and such a system was unconstitutional, because it infringed the liberty of contract and rights of property. Liberty of contract cannot be interfered with under the guise of protecting the public interest, when the legislative action which contemplates it is arbitrary or without reasonable relation to some purpose which the state has the power to effect. Two years ago the Supreme Court declared the wages-fixing powers given to the Kansas Industrial Court unconstitutional. It refused, in handing down the more recent decision, to pass upon the question whether the fixing of the hours of labor would be valid if independent of a compulsory arbitration system applicable to all business of a particular class, declaring that the case before it did not require it to express an opinion on this point.

Attack on Bond Issue for Municipal Plant Based on Technicality Overruled.—The Supreme Court of Iowa, in the case of the Lee Electric Company vs. City of Corning, upheld a decision of the lower courts declaring legal a bond issue of the city of Corning which had been attacked by the electric company. The city had voted to build a municipal electric plant and to issue bonds "not to exceed" $60,000 for this purpose. The Lee Electric Company maintained that the use of the phrase "not to exceed" was illegal because the statutes required that a definite amount of bonds be specified. The court, however, ruled that the use of this phrase was in substantial compliance with the statute. (202 N. W. 585.)

Federal Court Takes Jurisdiction of Idaho Rate Case.—The United States District Court for Idaho has overruled a motion made by the Attorney-General of the state to dismiss the bill of complaint recently filed by the Idaho Power Company for the purpose of effecting a complete review of valuation and rate decisions handed down by the Idaho Public Utilities Commission. Because the Idaho Power Company had not requested a rehearing before the commission, the Attorney-General insisted that the company had not exhausted its legislative remedy and that no appeal could be taken to the courts until such rehearing had been demanded and acted upon by the commission. The court overruled this contention, stating that under the circumstances presented it should take jurisdiction.

Under Kentucky Statutes Steam as Well as Hydro-Electric Companies Can Condemn Land for Transmission Lines.—The Court of Appeals of Kentucky ruled in the case of Smith vs. Kentucky & West Virginia Power Company that any electric company was authorized to institute condemnation proceedings where necessary to obtain transmission-line right-of-way, compensation to be determined in the same manner as provided for in the case of railroads. The statute as originally drawn in 1908 referred particularly to companies generating electricity with water power and gave them condemnation rights on streams and public highways, and the contention was made that a steam-electric company had no such power. The Court found, however, that in 1916 the statute was amended to include all companies generating electricity and gave them full rights of eminent domain. Damages of $1,000 for a right-of-way through the center of a farm valued at $10,000 were not, the Court said, so flagrantly against evidence placing the damage at two or three times as much as to invalidate the jury's finding. (269 S. W. 310.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Quality of Service an Element in Rate Fixing.—In a rate case affecting the Warsaw Gas Company the Indiana Public Service Commission declared: "The commission has given in the past and will continue in the future to give full consideration to the quality of service furnished by a utility as a vital element in fixing rates. In other words, the quality of service should be reflected in the rate of return. Therefore, the utility holds within itself, to that extent at least, one of the vital elements in determining a fair return. The commission is of the opinion that a utility furnishing a poor quality of service is not entitled to as large a rate of return as one furnishing good service. In other words, the incentive to furnish good service would be to allow a company furnishing such service a greater return than one furnishing poorer service."

Extensions in Unremunerative Territory.—Overruling the refusal of the Central Maine Power Company to extend service to certain would-be customers, the Maine Public Utilities Commission said: "The respondent company recognizes its obligation generally to serve all parts of the territory which it is occupying and to make any extension which will show to the company a fair return upon its investment in the particular extension, and the company expresses its desire to make an extension in most cases, if it can be assured that it will not be obliged to operate at a loss and that there is a prospect of increased revenue. It does, however, contend that in extensions of this kind a gross revenue of from 30 to 33 per cent ought to be assured. The company's claim as to the amount of gross revenue required in extensions of this kind is not convincing. We have not heretofore in cases of this kind, and shall not in the instant case, attempt to fix and determine definitely any specific percentage of revenue which must be assured in all cases before the company ought to be required to extend its service to a rural community. Such percentage of gross revenue to total investment must necessarily vary with the varying circumstances and conditions surrounding the different cases in which extensions are requested. The requirement in each case must be determined after a full consideration of the evidence submitted, taking into account all the facts, circumstances and conditions pertinent to such case. . . . A utility, however, ought not to be required to make extensions when an undue burden would thereby be imposed upon the company or upon its other customers, and prospective customers requesting service extensions who are so situated that such extensions can only be made at an additional or unusual cost must contribute thereto, either in the form of higher rates or otherwise, to such an extent that no undue burden will thereby be created."

Manufacturing and Markets

Are Electric Goods to Bear Union Label?

New York Fixture Manufacturers Unite to Resist Interference with Wired Fixtures—Panelboard and Switchboard Situation in Chicago—Other Cities and Products Involved

A GREAT deal of interest is being shown by electrical men in New York City and elsewhere in the situation that has arisen because of the stand taken by the Electrical Board of Trade of New York on the visibly increasing effort on the part of organized labor to bar out of all buildings where union labor is employed any lighting fixtures that do not bear a union label unless they are unwired, dismembered and rewired by the workmen of the local electrical union. As was recently reported here, the matter has been put in the hands of Charles L. Eidlitz, chairman of the board of governors of the Board of Trade, to take what action may be possible in so far as the conditions in New York may be concerned. The problem broadens and assumes national proportions, however, with the reporting of restrictions against other electrical equipments, and particularly when it is considered that Chicago, St. Louis, Cleveland, Boston and other cities, principally in the Middle West, are involved.

In Cleveland and St. Louis the electrical workers' unions have openly taken the stand that lighting fixtures will not be installed by them or permitted on the premises unless they have been wired by union labor and bear the union label. In Chicago this principle has been extended also to switchboards and panelboards. Already in New York there have been numerous recent instances of refusal by labor leaders to permit the installation of laundry machinery, printing machinery, blower units and other combined equipments that are received from the factory with a motor and controller and sometimes a driven machine mounted on a common bedplate and wired in conduit permanently fixed on the bedplate and the frames. Under threat of strike the wiring on these equipments has been torn out and reinstalled by members of the local union and a union label affixed.

SITUATION FAR-REACHING

The seriousness of the situation lies in the fact that once the principle is established that union labor will not install electrical materials that do not bear the union label it is but a matter of time when not only panels, switchboards and fixtures but sockets, switches, controllers, wire, cord, conduit, insulators, motors, generators and all kinds of electrical materials will be required to bear the union label or be barred from the job. If this control over electrical materials can be gained in one city, it will be only natural for the unions of other cities to strive to establish the same restrictions. The result will be that manufacturers of electrical apparatus and supplies produced under open-shop conditions will find themselves shut out of the principal markets of the country.

The history of the panel and switchboard situation in Chicago is cited as a pertinent example of what the effect of such a condition would be. In 1912 the Chicago electrical union organized the workers in the local panel and switchboard factories and required that contractors install only union-made boards. Whereupon certain manufacturers entered into an arrangement with the union providing that, since the manufacturers were hereafter to use only union-made materials, the union should not install any panels or switchboards not made in Chicago. This was clearly not an attack on non-union goods but a conspiracy against all products not made locally. In 1917 the United States government brought a suit which resulted in heavy fines against these manufacturers, and the head of the electrical workers' union went to jail. Despite this action, however, the conditions have been aggravated, with the result that panel and switchboard makers and more lately fixture manufacturers outside of Chicago have had to withdraw from that important market. It is, of course, economically impossible to ship switchboards or panelboards disassembled, for this would mean assembling in the factory, disassembling and reassembling on the job by men unfamiliar with the product. Therefore outside manufacturers who operate under open-shop conditions cannot sell in Chicago.

The success of the unions of Chicago in restricting the use of panelboards and switchboards not bearing a union label led them to an extension of the principle to embrace lighting fixtures, and was not long in impressing itself upon the attention of union leaders in other large centers. As a result lighting fixtures have come under the union ban in other cities also. At the present time about $250,000,000 of electric lighting fixtures are produced in the United States, and of the total about half are shipped completely wired and assembled. Higher-grade fixtures are virtually all assembled at the factory because any other method is impossible owing to the intricacy of the wiring and the perishable nature of the product. The action of organized labor in Chicago, St. Louis, Cleveland and the other cities involved now prevents the sale and shipment of these wired and assembled fixtures in these communities, unless knocked down and rewired when they reach the job. There are said to be cases known where this interference has been overcome on the ground by agents of the manufacturers through the influence of graft. Also, certain manufacturers are understood to be supplying goods to these restricted centers through the purchase of union labels which are attached to their product, although it is not "union-made." The entire practice would seem to be not only illegal but highly immoral and should inevitably bring action from the Department of Justice to end what is obviously a restraint of trade.

Action by the Electrical Board of Trade of New York has been brought to a head by a movement on the part of labor leaders to combine the two "chandelier unions" of New York City into "one big union" and by a series of recent incidents in which labor delegates have refused to permit the installation of laundry machinery, blower equipment, lighting fixtures and electric signs on various jobs, where the equipment was delivered wired and assembled. To protect themselves against this move, which they fear will be followed by an attempt to declare "unfair" all fixtures that do not bear the union label, all the important fixture manufacturers have joined the Electrical Board of Trade and put the protection of their interests into the hands of Mr. Eidlitz.

Economic Conference

International Chamber of Commerce to Hold Third Congress in Brussels in June

THE International Chamber of Commerce will hold its third congress in Brussels, Belgium, on June 21-27 inclusive. Some of the most disturbing economic questions before the world today will be discussed by representative business men from many countries. Economic restoration will be the keynote of the meeting, in itself an extremely serious subject and one that affects the welfare and prosperity of every country in the world. It has to do principally with the problems arising out of the adoption of the Dawes plan and the alarm which manufacturers in many countries have expressed over the fear of an inundation of manufactured goods from Germany in the discharge of her reparations obligations. The troublesome question of the payment of the international war debts is an allied subject, since it, too, involves the transfer of goods from one country to another. Fred I. Kent, vice-president of the Bankers' Trust Company, is marshalling much vital information on this topic and will take a leading part in the discussion. The remaining subjects of the Congress are of a more technical nature. They are divided into three classes — finance, industry and trade, and transportation. Richard F. Grant, president of the Chamber of Commerce of the United States, will preside over the deliberations of the finance session.

The International Chamber of Com-

nerce was created in June, 1920, and embraces representative organizations of industry, trade and banking in the principal countries of the world. It is a clearing house for information about international trade and trade practices. In its roster are found 329 chambers of commerce and fifty trade associations. The work of the international organization was instrumental in the formulation of the Dawes plan, which was the result of one of its economic conferences. Bringing to bear, as it does, the thought of leading business men on puzzling economic difficulties, the sessions of the international chamber are always fruitful and valuable.

Dictionary and Code

Functions of One Like Functions of Other—Not to Write Rules but to Describe Them

BY R. S. HALE
Chairman N.E.L.A. Wiring Committee

A CODE only describes practice. It does not make practice — though describing practice may influence the use or non-use of what is described. A dictionary tells about the language. It does not make the language or determine whether a spelling is the best conceivable.

Johnson, Noah Webster and others have attempted from time to time to make changes in spelling, and so have the simplified spelling boards. When they happen to suggest a useful change it is adopted, if it is good in itself, but not because of authority. Most of the changes in spelling since Chaucer or Shakespeare have come into use without any special authority.

Today, however, the writers of dictionaries that are good dictionaries do not attempt to guide the language. They know that their business is to describe, not to guide.

It would seem obvious that codes will go through the same process. The code writers will finally recognize that they are describing practice, and though they may influence the use of what they describe, it is not their business to make practice. A good engineer is wasted as a code writer, just as it would be foolish to ask a great writer to read books and newspapers in order to find for the dictionary the new words that others invent. It is also obvious that a code can never be up to date, just as a dictionary can never include the new words or new spelling that the language has adopted since the dictionary was written.

PREVENTING PROGRESS

Sometimes attempts are made to use a code so as to prevent progress, just as on some newspapers or periodicals the proofreaders are ordered to keep out any words not in the printed dictionary adopted by the editors. Codes describe what the writers think is good practice or ought to be good practice, but when it is suggested (or legally ordered) that no change shall be made in actual work until the authors of the code get around to a revision, there is trouble.

Just like the editor who adopts a standard dictionary for his own periodicals, this policy involves an assumption that while some people shall stick by the code, other people shall depart from the code.

Suppose all the editors had adopted Johnson's dictionary and no one had ever been allowed to print any word not in the dictionary! Where should we have obtained the words for engineering and sports and business that we need today to "carry on"?

The sooner it is realized that we need to use our good engineers to advance practice, just as the good writers of English advance the language, and that another type of mind is needed to record that practice in the codes, just as dictionary readers record what are the words and spelling and locutions that the good writers do use, the sooner we shall be able to use codes more efficiently.

To write a good code requires ability, but it is the ability to record accurately what it is that the best engineers are doing, just as it requires ability to write a dictionary that accurately shows what words and spelling are being used by writers who are being read.

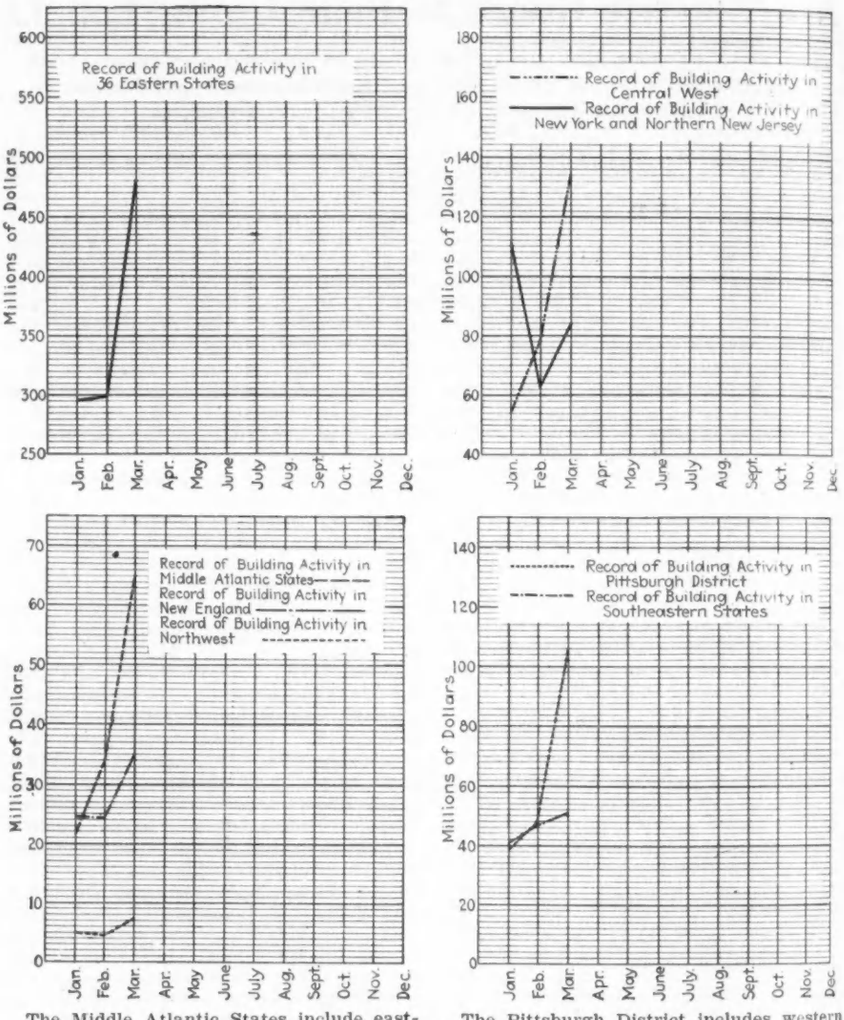
I think it pretty well understood that when laws are codified those who codify are supposed carefully to avoid writing new laws. Then after the laws are codified new laws are added just as fast as the lawmaking body wishes. We need code writers to codify the immense body of practice, but these code writers should merely show what it is that the engineers consider good. As code writers they should be recorders, not designers or inventors.

It is interesting to note that the electrical code committee is working

Building Contracts in Thirty-six Eastern States by Territorial Divisions

The Contracts in these States Include About Seven-Eighths of the Total Construction Volume of the Country

(Compiled from the F. W. Dodge Corporation Building Reports)



The Middle Atlantic States include eastern Pennsylvania, southern New Jersey, Maryland, Delaware, District of Columbia and Virginia.

The Southeastern States include North and South Carolina, Georgia, Florida, Tennessee, Alabama, Mississippi, Arkansas and Louisiana.

The Pittsburgh District includes western Pennsylvania, West Virginia, Ohio and Kentucky.

The Central West includes Illinois, Indiana, Iowa, Wisconsin, Michigan, Missouri, Kansas, Oklahoma and Nebraska.

The Northwest includes Minnesota, the Dakotas and northern Michigan.

along these lines. Or at least I hope that I interpret correctly its provisions for standing committees to study and watch changes in practice.

Such committees, like the readers for the dictionary firms, should be at all times watching the engineering and other periodicals for developments in good practice. Just as the readers for the dictionaries report a new word as soon as they find it in sufficiently frequent use to make them feel sure it will be used more and that people will want to look it up in the dictionary, so the standing committees of the code committee, whenever they find a new development used enough to make them feel sure it will be used more, will report it to the general committee for inclusion in the code. Then, like dictionaries, new editions of the code will not come out at definite dates, one or two or five years apart, but will depend on when the amount of new matter becomes more than can be conveniently handled by an appendix.

The adoption of a new word into the language never waits for the approval of a committee. If a dictionary leaves it out, it is much the worse for the dictionary. A new engineering method to be good never waits for approval by a committee. If a code leaves it out, that only makes the code a poor one.

Hoover Prefers Industry to Gather Its Own Statistics

TO ASSIST in preserving fundamental statistics, the Bureau of the Census will continue to do special work for the industries that have abandoned this type of activity as a result of the legal uncertainties surrounding this service. Secretary Hoover states that he is very anxious to see the government relieved of the necessity of handling these figures. He believes they can be compiled more efficiently by the industries themselves. To find the funds to carry on this work presents a serious problem, but he is willing to make an extra effort in that direction until some clear-cut trade statistics case shall have been decided in the courts. Special statistical work is being done for each industry that has requested the service with two exceptions. In these two cases the requests come from open-price associations, with which the department will have no relations.

Business Conditions

STEADY conservative buying of materials is noted in the industry, with no particularly large orders for general supplies. Competition is very keen and prices are quoted on close margins. In some instances orders are reported as spotty with no orders for a few days, and then several days are noted when fairly good-sized orders have been received, so that the total volume is good. Electrical men feel that if they were assured that business would continue this way and not taper off they would be satisfied. Fundamental underlying conditions are good, and there is no real reason why business should not continue in the present vein or even improve.

The steel industry is most active in the purchase of equipment. The Westinghouse Electric & Manufacturing Company has announced a million-dollar order received from the Carnegie Steel Company. Another manufacturer has received orders for mill-type motors amounting to $17,000 from another steel company, which is now in the market for approximately $58,000 worth in addition. Two large orders now pending, one of which is expected to be closed very shortly, cover $275,000 and $300,000 worth of steel-mill equipment. Central-station companies are buying equipment steadily, the most active demand being for transformers, line materials and watt-hour meters. The National Industrial Conference Board has announced that a steady advance toward better and sounder conditions in industry and business generally is revealed by the monthly report on wages, hours and employment for February.

In New England power equipment has been active, and sales of cable, wire and pole-line hardware are good. Better conditions are evident in industry in that section. Buying is in steady volume in the New York district, and central-station companies are purchasing line materials in good volume. In the Southeast central-station buying is good, and there is a steady demand for the general line of electrical supplies. Sales are sustained but in conservative measure in the Middle West. Various utility companies are purchasing quantities of apparatus in that territory, and railroad purchasing is active. On the Pacific Coast business is marking time. Power companies are placing good orders in that section for maintenance and distribution line extension.

Domestic Metal Markets Improved by Better Foreign Conditions

COPPER, zinc and lead prices have reached new lows for the current movement. The stronger markets in London in all of the metals except silver have improved sentiment and resulted in advancing quotations here for copper, zinc and tin. No turn in lead prices is yet in evidence. Consumers generally are continuing to buy from hand to mouth, apparently preferring to wait until more strength appears before taking any speculative interest in the market. Copper prices fell rapidly from the 13¼-cent delivered level of last week Wednesday but have since improved and quotations are now at the 13⅜-cent level, though some business has been done between these figures. Most of the buying has been for May delivery, but consumers are beginning to show some interest in June requirements. Forward buying has not been in nearly so much evidence recently. An encouraging factor for the copper industry is the announcement of a cut in production by one of the largest producers. This is to take effect immediately and will amount to about 5,000,000 lb. per month.

The weakness of the lead market has been well illustrated by the rapidity with which downward revisions in the contract prices of the American Smelting & Refining Company were made. Zinc prices declined to 6¾ cents last week Saturday, when several hundred tons were sold at that level. A few good-sized orders were placed during the week, and some interest was again shown in the export market. With an improved market in London prices of Straits tin in New York moved upward daily.

NEW YORK METAL MARKET PRICES

	April 15, 1925 Cents per Pound	April 22, 1925 Cents per Pound
Copper, electrolytic	13¼	13.30–13¾
Lead, Am. S. & R. price	8½	7½
Antimony	13	11½
Nickel, ingot	31	31
Zinc, spot	7.30–7.35	7.20
Tin, Straits	50¼	52½
Aluminum, 98 to 99 per cent.	28	28

Base copper price April 15, 1925, 16 cents.

Central-Station Buying Good in Southeast—Supply Sales Good

PURCHASES in the Southeast are spread over a general line of electrical supplies with central-station equipment constituting the bulk of the orders. The Alabama Power Company has recently placed orders for a portion of materials that will be required for the construction of approximately 800 miles of transmission line, one order alone amounting to $40,000 worth of guy strand, with orders yet to be placed for a considerable portion of the remainder of the necessary materials. Florida is also very active in line building, and one order was recently received for creosoted-pine poles amounting to $26,000. Another notable order from the central-station field this week was for $61,000 worth of varnished-cambric, lead-covered cable. The sale of house-type watt-hour meters has held up better this spring than usual, with the 10-amp. size predominating. Distribution transformers in sizes of 1½ kw. to 25 kw. are in brisk demand.

The Birmingham and New Orleans districts occupy the forefront in the electrical activities of the Southeast, and Florida continues almost on a boom basis. Orders from contractor-dealers in these sections are very satisfactory, the purchases representing practically all classes of electrical materials. Panelboards are in particularly good demand, and purchases of new lighting fixtures by office buildings have been more noticeable than usual this spring.

Power Equipment Active in the New England District

AN INCREASING interest in electrical supplies and apparatus was evident in the New England district. This trend is reported from various sources. A contract for an 8,000-kw.

waterwheel generator for Maine was received by one manufacturer and amounted to about $70,000. Another manufacturer records the sales of one 250-kw. dual-drive exciter unit to the Boston Elevated Railway, and a similar unit of 150 kw. capacity to the Lynn Gas & Electric Company. In addition, a small surface-type air-cooler was sold to the Boston Edison Company, the three units amounting to about $25,000.

Considerable activity is also reported in the sales of cable, wire and line hardware, and a fair demand for motors is manifested. Welding apparatus and equipment are noticeably strong and a good volume of sales is reported for the territory. Electric heating furnaces continue to attract much attention. Two electric delivery trucks have just been purchased for laundry service at Salem, Mass., making a fleet of sixteen electric trucks now used by the purchasing company. Several contracts for wiring installations are reported. In addition several large wiring projects are pending in various cities in Massachusetts.

Domestic appliances are selling fairly well. Better conditions are evident in industry throughout the factory and mill centers. In some cases mills are on an overtime basis. Several large bank and mercantile building projects are expected to materialize soon.

Buying Sustained but Conservative in the Middle West

BUSINESS continues good in the middle West, and indications are that manufacturers are making plans for a long period of sustained, although conservative, business activity. Various utility companies are purchasing quantities of apparatus, and railroad purchasing has been quite active. Among the interesting orders placed this week, was one for four 1,500-kw. mercury-arc rectifiers (two rated at 12,000 volts and two at 33,000 volts), to be used in the Chicago District and another for 300,000 lb. of weatherproof wire and cable. Power-transformer business in the middle West territory, in ratings above 500 kva., is running at approximately twice the volume for April that it did in March and well ahead of last year. This business is fairly evenly divided between utility and industrial purchases.

Jobbers' sales have been uniformly good and well diversified. While the volume of business was not exceptional, the jobbers are generally satisfied. The contract for the construction of the new thirty-million-dollar Stevens Hotel in Chicago was let this week.

Prices have been somewhat erratic. Standard electric porcelain was reduced 10 per cent, fir cross-arms 4 per cent, flexible non-metallic conduit approximately 10 per cent and outlet boxes 10 per cent. Lamp cords, code wire and lead-covered cable prices were also reduced slightly, and the price of armored cable was reduced 5 per cent for Cook County. It is felt by a number of code wire manufacturers that most of the low-price protection orders of last fall are about completed and that the time is approaching when large specifications will be out. They are apparently attempting to bring the price of code wire to a figure at which the prospective buyer will again buy heavily.

Buying in Steady Volume in the New York District

BUYING of equipment and supplies by both central-station companies and industrial plants is in steady volume in the New York district. Sales of insulators, transformers, air-break switches and watt-hour meters are moving in very good volume. An industrial company is now in the market for eight transformers totaling 6,150 kva., and many other inquiries are being received. A manufacturer of circuit breakers, switchboards, etc., reports that sales in March and April were both better than last year with both months about equal in volume.

Central-station companies have been buying line materials in good volume. Changes in the distribution voltages of two companies, one of which is just getting this work under way, have resulted in the placing of many orders for this class of equipment. Some 11-kv. rural line development in eastern Pennsylvania is also contributing to the volume of orders. A change of ownership of certain central New York properties has held up the placing of orders expected from that section. Sales of motors are in fair volume and have not been affected by the recent price reduction. Competition is keen, with orders being taken on a very small margin. Jobbers find business spotty, but have noticed an improvement in the last few days.

Business Marking Time on the Pacific Coast

BUSINESS is still marking time on the Pacific Coast. Decreased contracting in some localities has produced considerable electrical unemployment. Railroad purchasing continues excellent, though less spectacular than recently, iron wire and dispatching apparatus furnishing the bulk of the business. Power company buying is good, although requisitions have been largely for maintenance. Construction work planned by central-station companies insures better business in such lines as high-tension insulators and pole-line hardware. Probably not more than two carloads of the former and eight carloads of the latter have been ordered in north and central California this year, but poles and cross-arms on order and in stock insure some fine insulator business by midyear. A recent order for the San Joaquin Valley covered a carload of 11,000-volt pin-type insulators. Competition on pole-line hardware business has been especially keen.

Export sales have been very good and include telephone and wiring equipment for Honduras, Hawaii and the Philippines. Dealers' orders are small and scattering. Prices are still declining, practically every standard line having been affected except wiring devices, and many of these have been reduced in package quantities. The Puget Sound Power & Light Company states that there are twice as many electric range prospects as last year, with the campaign having practically a month to go, and the city of Seattle has reported equally favorable conditions in its campaign now under way.

Activities of the Trade

Brown-Boveri Gets Order for Arc Rectifier for Industrial Use

Brown, Boveri & Company announce the sale of a 2,000-kw. installation of iron-clad mercury-arc rectifiers for 500-volt, three-wire direct current service in a large industrial plant at Detroit. This order, which is the second received from this plant within six months, resulted from the satisfactory operating experience gained from the first installation and the greater efficiency of this type of apparatus for the particular service.

Truscon Steel Company Receives Large Orders for Steel Poles

The Truscon Steel Company, Youngstown, Ohio, through Frederick Maples, manager of the steel-pole department, announces the receipt of two large orders recently. The first order, amounting to almost $250,000, was for 1,000 Truscon steel poles. This order was placed by the Georgia Railway & Power Company, and the poles are to be used in construction of that company's 110,000-volt line from Augusta to Toccoa, Ga. Nine hundred of these poles are to be 55 ft. high and 100 are to be 60 ft. high.

The second order was for 1,500 poles and was received from the International General Electric Company for use in connection with a railroad electrification project in Brazil. These poles were of the copper bearing steel type and are to be from 35 ft. to 50 ft. in height.

Geier Company Holds Sales Convention at Cleveland

More than fifty salesmen of the P. A. Geier Company of Cleveland gathered in convention at the factory during the week of April 13 to inspect the new model "Royal Standard" and "Super Royal" vacuum cleaners which the company is about to place upon the market and to study the advertising material and merchandising methods under which these new products will be sold.

"Our selling force, our advertising program and our production schedules are all larger than ever before in our history," announced F. J. Gottron, general manager of the company. "While we, in common with other household appliance manufacturers, suffered some disappointment in 1924, there has been a very satisfactory increase so far this year. From the considerable number of new dealers we secured during Feb-

ruary and March, we have come to believe that the trade has assimilated the radio fad and is again giving the attention to appliance selling which staple merchandise deserves."

Westinghouse Gets Million-Dollar Order from Carnegie Steel

The Westinghouse Electric & Manufacturing Company has received an order valued at approximately $1,000,000 from the Carnegie Steel Company for electrical equipment for the new steel mill at Homestead, Pa. This is one of the largest orders ever placed for electric steel-mill equipment. The order calls for three electric motors with flywheel motor-generator sets and auxiliary equipment. The mills will be driven by one 8,000-hp. and two 7,000-hp. reversing motors.

Habirshaw Receivership Expected to Be Lifted by June

The committees representing the creditors and security holders of the Habirshaw Electric Cable Company have agreed on terms of a reorganization plan which is expected to receive the approval of the court and will result in the lifting of the receivership in June. Under the terms of the plan a new company is to be formed to acquire the various properties involved. The authorized capital stock of the company as proposed will consist of 170,000 shares of stock of no par value. Of this it is expected that 20,000 shares will be sold to W. A. Harriman for $3,000,000 cash to carry out the plan, while 150,000 shares will be distributed among the depositors, a proportionate amount being reserved and sold for cash, in the event of not gaining the assent of 100 per cent of the creditors, for the benefit of the dissenters.

Stockholders of the old companies are expected to receive nothing except the rights to subscribe to new stock. All the new stock is to be issued under a voting agreement for a period of three years from the date of the formation of the new company, the trustees electing the board of directors for the period. It is proposed that George H. Walker, president of W. A. Harriman & Company, shall be chairman of the new company, and the present operating management under John S. Worely will be continued.

Westinghouse Sales for Fiscal Year Show Decrease

Sales of the Westinghouse Electric & Manufacturing Company for the three months ended March 31, the final quarter of the company's fiscal year, are estimated to be $35,834,000, as compared with $38,654,000 in the quarter ended December 31 and $37,861,000 during the corresponding period of last year.

Sales for the year ended March 31 are approximately $149,119,000, as compared with $163,780,000 for the preceding year, which is a decrease of about 8 per cent. Sales billed for the year ended March 31 were about $159,404,000, which is higher than those for the preceding year, which were $154,413,000.

New Corporation to Manufacture Household Utilities

Frank M. Eldredge, president of the Eldredge Advertising Agency, has organized and filed articles of incorporation, March 3, 1925, under the laws of Michigan for the Electrical Necessities Corporation with an authorized capital of $150,000. The officers and directors are all residents of Detroit. The object of the corporation is to manufacture, sell and distribute throughout the world electrical products for household utilities.

The company has leased a factory at the corner of Leib and Larned Streets, Detroit, with 12,000 sq.ft. of floor space and is now in active operation. The new corporation is the outgrowth of the Gem Manufacturing Company, Inc., manufacturer of electrical cooking appliances, which was incorporated March, 1924, with J. L. Webber as president, J. B. Webber as vice-president and Frank M. Eldredge as secretary and treasurer. The Gem Company will be absorbed by the Electrical Necessities Corporation, and the various items previously sold by it will be continued and sold by the new corporation.

Weston Electrical Instrument Reports Gain in Sales

Sales of the Weston Electrical Instrument Corporation, Newark, N. J., for the first three months of this year are more than 23 per cent ahead of the same period last year. This statement was issued at the annual stockholders' meeting of the company held this week, at which the officers and directors of the company were re-elected.

The Wagner Electric Corporation, St. Louis, announces the removal of its Pittsburgh Service Station to 4909 Liberty Avenue.

The Serv-el Corporation, 510 North Dearborn Street, Chicago, has announced that orders for refrigerating machines received during the first quarter of the year amounted to $750,000. Deliveries in the first quarter of this year were 50 per cent greater than in the last quarter of 1924.

The Western Electric Company has recently occupied its new building at Kansas City, the construction of which was announced in the May 24, 1924, issue of the ELECTRICAL WORLD. This new building has 44,000 sq. ft. of floor space, as against 2,500 sq. ft. of the first house established by the company in that district in 1903.

The Swartzbaugh Manufacturing Company, formerly the Toledo Cooker Company, Toledo, is now placing on the market the new "Everhot" electric cooker in two sizes. It is equipped with a four-station reciprocating heater switch and is provided with a temperature dial in the cover.

The Sandoval Sales Company has opened offices at 115 Jessie Street, San Francisco, and will act as a manufacturers' agent. The company already has the exclusive distribution of the Wesix line of air heaters, water heaters, thermostats and steam boilers for northern California and Nevada. A Los Angeles office is to be opened soon for distribution of the same line in southern California, Arizona and New Mexico. H. E. Sandoval, formerly manager of electric sales of the Pacific Gas & Electric Company, is president and manager of the new company.

Chas. Cory & Son, Inc., 183 Varick Street, New York, announces the opening of a district office in Chicago, at 22 West Quincy Street, in charge of Harry D'Almaine, to serve better its increasing customers in that territory. Among the important equipments manufactured by the corporation are valve controls, interlocks, ohmmeters, flow meters, central-station load indicators, turbine order signals and many other products.

The Cutler-Hammer Manufacturing Company, Milwaukee, manufacturer of motor starters, control equipment, etc., announces the removal of its New York sales office at 50 Church Street and its Times Square (New York) office to 8 West Fortieth Street.

The R. Thomas & Sons Company, East Liverpool, Ohio, announces the addition to its sales staff of Walter S. Whiteman, who will cover western Pennsylvania, eastern Ohio and southern points, with headquarters at New York; also C. E. Remaly, who will cover western Ohio and points in the middle West, with headquarters at Chicago.

The Indiana Electric Utilities Company, electrical and radio supplies, announces that it has moved its offices from 10 North Clark Street, Chicago, to room 622, Illinois Merchants' Bank Building, Chicago.

The General Electric Company, has redesigned its hand-starting compensators, known as the type CR-1034, for use on alternating-current circuits for starting squirrel-cage induction motors. Temperature overload relays have been incorporated in the compensator, replacing dashpot overload relays, and in one of the sizes multiple-rated autotransformer coils are used instead of the single-rated variety. The redesigned compensators also include an improved push-button mechanism, containing an attachment for resetting the temperature overload relay.

S. D. Sprong, consulting engineer, announces that since April 10 his new address has been Room 505, 15 Moore Street, New York City.

The Geo. W. Smith Company, manufacturers' agent, representing Schweitzer & Conrad, Inc., the Page & Hill Company, and the Electric Service Supplies Company, announces that it has moved its sales department to 521 South Akard Street, Dallas, Texas.

The De La Vergne Machine Company, 910 East 138th Street, New York City, announces the sale of two 200-hp. vertical Diesel engines to the municipal plant at Wetumka, Okla. Other sales announced at this time cover seventeen Diesel engines aggregating 3,260 hp.

The Seward Wire Company, Camden Avenue, Parkersburg, W. Va., will proceed with the construction of two additions to its plant, at a cost of about $25,000, comprising a main one-story structure, 30 ft. x 130 ft., and a two-story building, 30 ft. x 90 ft., both of which will be given over to the manufacture of rubber covered wire.

New Equipment Available

Two-Speed Synchronous Motor

A salient-pole synchronous motor which can be run at either of two speeds without changing the frequency of the power supply has been developed by the General Electric Company. One of these machines has already been built, rated at 5,000/2,500 hp., 600/300 r.p.m., for operation at unity power factor. Possible applications of such a motor would be in mine ventilation, ship propulsion and, when used as a generator, in generation of hydro-electricity.

The revolving poles of the two-speed motor are fitted with a special shoe of such form that each two adjacent poles can be excited with the same polarity. Thus the motor can be connected for either normal or one-half normal number of poles by throwing a pole-changing switch for the stator winding and a reversing switch for the field winding. Operated as a generator, it is possible to obtain two frequencies at the same speed or the same frequency at two different speeds.

Automatic Control Equipment for Oil Burners

A complete line of automatic-control equipment for both domestic and industrial oil-burner installations has been developed by the Absolute Contactor Corporation, Beloit, Wis., and includes a slow switch, guard switch and lock switch. The guard switch is mounted in the furnace stack, controls the ignition circuit and safeguards the burner operation. When used in connection with the slow switch, the guard switch protects the installation in case the burner fails to ignite. The lock switch affords additional protection during ignition by re-energizing the ignition circuit for three minutes after failure to ignite, at the end of which period all operation is stopped. A feature of all switches is the "Con-tac-tor" mercury switch, which is designed to perform a large number of operations without deterioration, oxidation or sticking. These switches have been developed to provide full and satisfactory safety control on motor-driven oil-burner equipment.

High-Intensity Floodlight

The B. B. T. one-half-billion-candlepower floodlight has been specially developed by the B. B. T. Corporation of America, 810 Atlantic Building, Philadelphia, for the lighting of landing fields for night flying, harbors, docks or large areas of land or water which it is desired to illuminate with high intensity. The instrument is composed of a large ground-glass lens built up of twenty-one dioptreque elements of circular dimensions so that it throws a light in a radius of 180 deg. The lens is contained in a heavy steel waterproof casing in which also are mounted the electric connections and mechanism for operating the light source. The light source consists of either a 20,000-cp., special 110-volt incandescent lamp or a standard automatic arc. The whole is mounted when desired on an adjustable chassis. The apparatus is mounted on three adjustable tripods so that the angle of light may be adjusted by hand. The projected light covers an area of approximately one-half mile square.

Twin-Type Graphic Meter

A new graphic meter into which two standard elements can be built, in which either strip or daily charts can be used, which occupies 30 per cent less switchboard space than separate meters and which gives two accurately synchronized records, has been developed by the Esterline-Angus Company, Indianapolis. The case has an over-all width of 15¾ in. Switchboard and wall types are available and portable types can be made. The back can be removed without disturbing electrical connections.

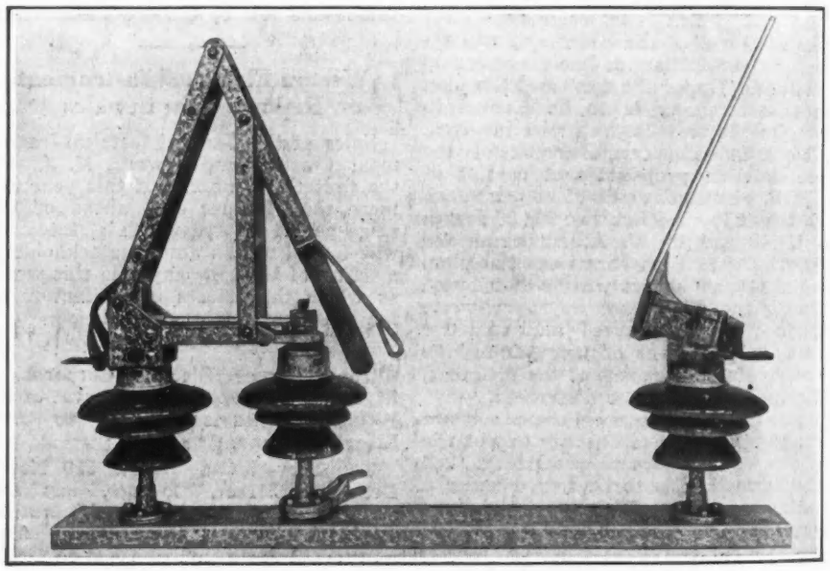
Four different types of chart drives can be furnished—clock, clock with governor, impulse-actuated and motor drive. For recording disturbances the twin meters can be furnished with motor drive and automatic trip to speed up the chart. The ink is fed by capillary action, the pen tube being carried on the moving element.

Railroad Welder

A new welder especially designed for use in railroad shops has been placed on the market by the Lincoln Electric Company, Cleveland. The welder is only 21 in. wide, and by the use of large roller-bearing wheels has been made easily portable. The frame is built of structural steel extending beyond the equipment on the truck, which is hung low so that it will not tip over. The machine employs the "Stable-Arc" and is of 300 amp. capacity. This equipment is said to provide a steady uninterrupted flow of heat, enables the operator to handle it with ease and gives great speed and a high quality of work. It is built to take care of such jobs as arc welding of locomotive frames, cross-head guides, welding on truck sides, main driving wheels, etc.

High-Voltage Pantograph Air-Break Switch

A high-voltage air-break switch utilizing a pantograph motion has been placed on the market by Schweitzer & Conrad, Inc., Ravenswood Avenue, Chicago. Straight-line movement of the blade is obtained by means of the pantograph motion, thus permitting the switch blade to enter a fully housed clip from the front. With the pantograph motion the blade in the open position requires only one-half the clearance of the ordinary switch blade. This reduces space requirements, especially in the higher voltage ratings when switches are mounted vertical or underhung. Complete protection of the clip



SINGLE-POLE, 400-AMP., 37,000-VOLT PANTOGRAPH SWITCH TYPICAL OF NEW LINE DEVELOPED

housing permits the use of a superior type of multiple floating finger and self-aligning contact clip which is said to insure good contact on the blade even under extreme distortion of the supporting structure. The pantograph motion produces a simple, positive, quick movement of the blade. Arcing fingers prevent damage to the contact end. The switch is made in 15, 37, 50, 73, 88, 110 and 132-kv. ratings, for horizontal-upright, horizontal-inverted, or vertical mountings, and is supplied with either manual or motor-operated mechanism.

Barbecue Unit.—A new driving mechanism for a barbecue unit, as used in tourist camps, etc., known as the "Prima," has been placed on the market by the Buckeye-Prima Company, Sydney, Ohio. The unit is mounted on an adjustable pedestal and is provided with a universal motor. A hand rheostat permits obtaining any required speed.

New Trade Literature

SINGLE-PHASE INDUCTION MOTORS.—A folder issued by the Century Electric Company, St. Louis, calls attention to the Century repulsion-start, single-phase induction motors for mechanical refrigerating systems, oil burners and house pumps.

SYNCHRONOUS MOTORS.—The Electric Machinery Manufacturing Company, Minneapolis, has issued bulletin No. 875 entitled "Synchronous Motors in Pulp and Paper Mills," in which it describes the use of the "E-M" synchronous motors in pulp and paper mills. It contains illustrations of installations in various plants and a chart showing different motor applications.

LIGHTING EQUIPMENT.—The B. B. T. Corporation of America, 810 Atlantic Building, Philadelphia, is distributing a booklet describing the "Scialytic" shadowless light, developed by the firm of Barbier, Bernard & Turenne, Paris, France, with the object of obtaining over a given area an illumination of high intensity and absolute quality which shall be entirely free from shadows. Illustrations are given showing various installations in hospitals with descriptions of the apparatus used.

CATENARY CONSTRUCTION. — Research Bulletin C-4 issued by the American Brass Company, Waterbury, Conn., describes and illustrates the Anaconda catenary exhibit on the General Electric Company's test track, Erie, Pa., between Bridges No. 44 and No. 46, which was erected to test and demonstrate the value of an all-copper-and-bronze catenary system developed by the American Brass Company, for meeting the growing demand for railroad overhead construction.

ELECTRIC CLEANER.—The P. A. Geier Company, 540 East 105th Street, Cleveland, Ohio, is distributing a folder calling attention to its new model K "Super-Royal" electric cleaner.

SAFETY HAND LAMPS.—The Crouse-Hinds Company, Syracuse, N. Y., is distributing bulletin No. 2071, describing and illustrating its various types of electric safety hand lamps.

VITRIFIED SALT-GLAZED CONDUITS.—"Barnard's Duct Vitrified Salt-Glazed Underground Clay Conduits" is the title of a catalog issued by B. S. Barnard & Company, 31 Union Square, New York City, selling agents for the Barnard's vitrified salt-glazed underground clay conduits, covering the Barnard underground clay conduits and tools and appliances used in connection with underground construction, including conduit plugs, wrappers, conduit rods, cable benders, cable protectors, cable hangers, conduit threading machines, steel fishing traps, etc. The company plans to issue from time to time additional bulletins showing illustrations of other tools and specialties for underground conduit requirements.

CONTROL APPARATUS.—A series of bulletins has been issued by the Cutler-Hammer Manufacturing Company, Milwaukee, with prices and dimensions of its electric control apparatus to bring its catalog up to date. Special attention is called to bulletins Nos. 2,660, 6,260, 9,181, 9,182, 9,682, covering its line of fire pump controllers; No. 3,291, small speed regulators; No. 9,410, secondary starter drums with the optional feature of primary switch interlocking contacts; No. 9,620, covering its transformer-type automatic starter for squirrel-cage motors, and No. 9,655, describing the automatic starting-speed regulator for alternating-current motors.

BOWL-ENAMELED LAMPS.—The Hygrade Lamp Company, Salem, Mass., is distributing a folder calling attention to the advantages of the Hygrade bowl-enameled lamps.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

Purchase and agency is desired in Jerusalem, Palestine (No. 14,550), for automobile servicing equipment, battery equipment and electrical accessories, electric horns with spare parts, positive plates for storage batteries and wood separators.

Purchase and agency is desired in Madrid, Spain (No. 14,552), for battery testers and separators and magneto brushes, electric wiring and connections for automobiles.

An agency is desired in Barcelona, Spain (No. 14,578) for electrical egg beaters; (No. 14,519) for galvanized-wire cables.

An agency is desired in San Salvador, Salvador (No. 14,557) for electrical lighting accessories.

An agency is desired in Lwow, Poland, (No. 14,543), for radio apparatus.

Purchase or agency is desired in Amsterdam, Netherlands (No. 14,575), for radio apparatus.

Purchase or agency is desired in Belfast, Ireland (No. 14,551), for superhetrodyne radio sets.

New Incorporations

THE ARKANSAS POWER COMPANY, Little Rock, Ark., has been incorporated to build hydro-electric power plants in Arkansas. The capital stock consists of 4,000 shares having no par value. The officers are: V. C. Pettie, president; Guy A. Watkins, secretary, and W. D. Dickinson, treasurer.

THE OKANAGAN LIGHT & POWER COMPANY, Oroville, Wash., has been chartered with a capital stock of $100,000 by Eugene Hockett, D. J. Broderick, Oroville, and L. B. Stedman, Seattle. The company plans to build a power plant in Oroville to supply electricity in the Okanagan Valley.

THE LAMB COUNTY UTILITIES COMPANY, Sudan, Tex., has been incorporated with a capital stock of $25,000 by R. W. Porter and C. C. McLaughlin.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

BOSTON, MASS.—The Edison Electric Illuminating Company has filed plans for the construction of a substation at 95-99 West Canton Street, to cost about $85,000. Contract for the building has been awarded. Bigelow & Wadsworth, 3 Hamilton Street, are architects.

LAWRENCE, MASS.—The Council has approved a proposal submitted by the Lawrence Gas & Electric Company for the installation of an ornamental lighting system consisting of seventy-nine standards, on South Broadway from Inman Street to Essex Street.

LYNN, MASS.—The proposal to install 1,000-cp. electric lamps throughout the city has been approved by the Chamber of Commerce. Under the proposed plan the system would extend from the Point of Pines River to the Swampscott line and from the Lynn-Saugus line to the Salem line.

Middle Atlantic States

ASHVILLE, N. Y.—The installation of a street-lighting system in the business section of the village is under consideration by the Village Board.

BROOKLYN, N. Y.—Bids will be received by the Chief of the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 6, for the erection of a radial brick stack, 200 ft. high and 10 ft. inside diameter at top, at the local navy yard (Specification 5077).

BUFFALO, N. Y.—The Marine Elevator Company, Chamber of Commerce Building, plans to install electric power equipment at its proposed grain elevator on the waterfront, to cost about $1,200,000.

JAMESTOWN, N. Y. — The Niagara, Lockport & Ontario Power Company, Buffalo, is arranging to take over and consolidate the Livingston-Niagara Power Company, Avon, Western New York Electric Company, Jamestown, Cambria Power Company, Buffalo, and the Bryant Power Company, Wilson. Plans are under way for extensions in transmission lines.

MOUNT MORRIS, N. Y.—Permission has been granted to the Mount Morris Illuminating Company to extend its system to serve a portion of the town not now served with electricity, and approval of franchise granted by the town has been given.

NEW YORK, N. Y.—The New York Edison Company plans alterations and improvements in its substation at 53-59 Duane Street, to cost about $10,000. The company has taken out a permit to erect an operating and office building at 323-41 Rider Avenue, to cost about $100,000.

WHITE PLAINS, N. Y.—Arrangements have been made by the Commissioner of Public Works and the Westchester Lighting Company, Mount Vernon, for the installation of 250-cp. lamps on Brookfield, Grove, Grand, Court, Spring and William Streets, from Martin Avenue to Hamilton Avenue. The company will also install a new lighting system at Silver Lake Park, to cost about $15,000. The present lamps will be replaced by 128 lamps of 60, 100 and 250 candlepower.

JERSEY CITY, N. J.—Plans have been filed by the Public Service Electric & Gas Company, Newark, for the erection of a substation at 41-47 Garfield Avenue, to cost about $40,000.

TRENTON, N. J.—The Public Service Electric & Gas Company, Newark, has acquired a site in the Fernwood district, for its proposed substation, to cost about $1,000,000.

WILDWOOD, N. J.—An ordinance has been passed by the Council providing for the installation of a new lighting system on the boardwalk now being built between Cedar Avenue and Twenty-sixth Street, to cost about $16,000.

WEST CHESTER, PA.—Bids will be received by the Board of Trustees, West Chester State Normal School, until May 7, for electrical work in the George Morris Phillips Memorial Auditorium. Price & Walton, 119 South Fourth Street, Philadelphia, are architects.

CAMP MEAD, MD.—Bids will be received by the Quartermaster, until May 4, for 335 electric meters (Circular 52).

CHURCHVILLE, MD.—The Belair (Md.) Electric Company plans to erect a transmission line from Belair to Churchville to supply service here.

GRAFTON, W. VA.—The Royal Window Glass Company contemplates the installation of electric power equipment in connection with the rebuilding of its plant, recently damaged by fire with loss of about $350,000.

PARKERSBURG, W. VA.—A committee has been appointed by the City Council to make investigations relative to installing a new street-lighting system.

LAWRENCEVILLE, VA.—The installation of an ornamental lighting system is under consideration.

SOUTH BOSTON, VA.—Interests associated with the Halifax Power Company are reported to have acquired the electric systems at Chase City, Emporia, Lawrenceville, Burkeville, Crewe, Blackstone and other towns. These plants, it is announced will be connected and power supplied from a central point at Meherrin Falls.

WASHINGTON, D. C.—Plans are under way for the installation of an improved lighting system on several of the main thoroughfares between now and the end of the calendar year. Warren E. Hadley is electrical engineer.

WASHINGTON, D. C.—Bids will be received by the Chief of Engineers, United States Army, Washington, until May 1, for watertight lighting fixtures (Circular '24).

WASHINGTON, D. C.—Bids will be received by the Bureau of Yards and Docks, Navy Department, Washington, until May 6, for four 300-hp. watertube boilers, with brick settings and mechanical stokers; one turbo-driven and one motor-driven forced-draft fan at the local naval hospital (Specification 5082).

WASHINGTON, D. C.—Bids will be received by the Chief Signal Officer, United States Army, Washington, until May 1, for battery parts, including 225 negative elements, 100 rubber jars, 1,000 rubber separators and 1,000 wood separators (Circular C. P. 19822-A-5); also, until May 4, for reel carts, cart carriers and spool carriers in lots of 20, 25, 30, 35, 75, 100 and 150 (Circular C. P. 20268-1).

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 8 for extensions at the Naval Hospital at Canacao, P. I., including the construction of new building, lighting systems for each building, power systems and telephone conduits in certain buildings, nurses' call systems in certain buildings, and outside electric distributing systems, including transformers, panelboards, conduits, ducts, wiring, etc.

North Central States

AUGUSTA, MICH. — The Consumers Power Company, Jackson, plans to build a transmission line to Gull Lake and vicinity for light and power service.

KALAMAZOO, MICH.—The proposal to make extensions to the municipal electric plant has been rejected by the voters.

AKRON, OHIO.—The City Council is considering the installation of automatic traffic signal lamps in the business section, to cost about $4,000. Lloyd Carter is city safety director.

ANDERSON, IND.—Bids will be received by the City Council until May 4 for a 6,000-kw. steam turbine generating unit with surface condenser and auxiliary equipment.

FORT WAYNE, IND.—The New York, Chicago & St. Louis Railroad (Nickel Plate System) plans to install electric power equipment at its proposed local locomotive and car repair shops and terminal, to cost about $2,500,000. J. K. Connor, Columbia Building, Cleveland, is engineer.

HAMMOND, IND.—Plans are being prepared by the Northern Indiana Gas & Electric Company for the construction of mechanical and service buildings at Sheffield and Hanover Streets, comprising a meter building, mechanical shop, and three meter houses. Buckley & Skidmore, Hammond, are architects.

KOKOMO, IND.—Preparations are being made by the Kokomo Steel & Wire Company for equipping its works throughout for electrical operation, at a cost of about $500,000. Electricity for operating the plant, it is understood, will be obtained from the Northern Indiana Power Company.

PRINCETON, IND.—Plans for the rebuilding of the local locomotive and repair works of the Southern Railway Company, Washington, D. C., recently damaged by fire include a power house. The loss is estimated at about $300,000. Dwight P. Robinson & Company, Inc., 125 East Forty-sixth Street, New York, is engineer.

PEORIA, ILL.—The installation of an ornamental lighting system on North Adams Street, covering five blocks, to cost about $5,000, is under consideration. The plans call for fifty standards, mounted with 300-watt Mazda C lamps, maintained by underground wires. J. J. Jeffries, City Hall, is engineer.

SPRINGFIELD, ILL.—Bids will be received by the Board of Trustees of the Springfield Sanitary District, City Hall, until May 15 for construction of east side intercepting sewers and appurtenances, including the Cook Street pumping station (section B) and five electric-motor-driven vertical centrifugal pumps having an aggregate capacity of 18,000,000 gal. per twenty-four hours (division D). Pearse, Greeley & Hansen, 6 North Michigan Avenue, Chicago, are engineers.

RACINE, WIS.—Arrangements are being made by the Wisconsin Gas & Electric Company for the erection of a number of rural lines in this section of the state. With the completion of the Yorksville-North Cape extension, a new line will be built on Highway 20 to Ives Groves, followed by another to County Line Road, 3 miles west of the lake.

REEDSBURG, WIS. — Steps have been taken by the Chamber of Commerce to secure the installation of an ornamental lighting system in the downtown section.

BRAINERD, MINN.—Plans are under consideration by the Wilcox Company for rebuilding its electric power plant, recently damaged by fire, with loss of about $50,000.

WINONA, MINN.—The Wisconsin Railway, Light & Power Company, it is reported, will soon take bids for extensions to its local system, including an addition to power house, to cost about $150,000. Meade & Seastone, State Journal Building, Madison, Wis., are architects.

CLARINDA, IOWA.—Bids will be received by E. E. Williams, city clerk, until April 28, for eighty electroliers for an ornamental lighting system. The Henningson Engineering Company, National Building, Omaha, Neb., is engineer.

IDA GROVE, IOWA.—The erection of a high-tension transmission line between Ida Grove and Arthur is under consideration by the Iowa Light, Heat & Power Company, Carroll.

LAWTON, IOWA.—The municipal electric plant has been acquired by J. C. Rousch, Onawa, and L. R. Schlichter, Sioux City. Improvements will be made to the plant, including changing the system from direct to alternating current.

NORBORNE, MO.—The Missouri Gas & Electric Service Company, Trenton, has acquired the municipal electric power and ice plant, and plans to erect a transmission line from Hardin to supply service here.

AURORA, NEB.—The Nebraska Gas & Electric Company, Omaha, plans to rebuild its local power plant, including the installation of additional equipment.

GENEVA, NEB.—At an election held April 7 the proposal to issue $40,000 in bonds for the installation of a municipal electric lighting system was defeated.

MILFORD, NEB.—Bonds to the amount of $23,000 have been voted for improvements to waterworks, including the installation of motor-driven pumping units.

O'NEILL, NEB.—Preparations are being made by the Northern Nebraska Power Company, Fairmont, for the construction of a 4,000-hp. hydro-electric plant on the Niobrara River, north of O'Neill, to cost about $450,000. Negotiations are under way between the officials of the company and the City Council for furnishing electricity to the city for local distribution. Acceptance of the proposal would necessitate the erection of a distributing system by the city or the purchase of the present system, owned and operated by the Minnesota Electributing Company, Minneapolis. Contracts have been made with Northern Nebraska and South Dakota electric distributing companies to take all of the surplus energy generated.

Southern States

ASHEBORO, N. C.—Plans for the proposed local furniture factory to be erected by the Cranford Chair Company include a power house. The equipment will include an 80-hp. boiler, engine, etc., and electrical apparatus.

ELKINS, N. C.—Bonds to the amount of $70,000 have been authorized for extensions and improvements to the municipal electric light plant and waterworks.

FRANKLIN, N. C.—Bids will be received by the Board of Aldermen until April 29 for construction of a 13,200-volt transmission line, 6 miles long, together with wiring in the power house and three outdoor-type substations; six steel Taintor gates complete, motor-driven hoists for wooden headgates, and five 100-kva. transformers, three sets of 13,200-volt lightning arresters and miscellaneous high-tension switching equipment. For details see Searchlight Section. Robert & Company, Inc., Bona Allen Building, Atlanta, Ga., are engineers.

HIGH POINT, N. C.—Bids will be received by the Mayor and City Council until May 7, extension of date, for waterworks improvements, including four motor-driven and two gasoline engine-driven centrifugal pumping units with starters and accessories. William C. Olsen, Raleigh, is consulting engineer.

VALDOSTA, GA.—Plans have been approved by the city officials for extensions to the ornamental street-lighting system.

COLCHATCHEE, FLA. — W. C. Kyle, Fort Lauderdale, and associates have acquired a local building which they will remodel and equip for an electric lighting plant and ice factory. The entire project will cost about $85,000. Colchatchee has not a post office.

HOMESTEAD, FLA.—The Redlands Ice, Power & Light Company has petitioned the County Commissioners for a franchise to erect transmission lines covering about 30 miles.

MEMPHIS, TENN.—The City Commissioners have authorized the installation of an improved lighting system on Second Street, to cost about $25,000.

NASHVILLE, TENN.—The City Council is considering calling an election to vote on the proposal to issue $100,000 in bonds for extending the electric light service into territory to be annexed.

CORDOVA, ALA.—The Stephenson Brick Company, North Birmingham, contemplates building a power house at its proposed local brick-minufacturing plant, to cost about $200,000.

FLORENCE, ALA. — Preparations are being made by the Alabama Power Company to rebuild its local substation, recently damaged by fire, causing a loss from $12,000 to $20,000.

BOLTON, MISS.—The Gaddis & McLaurin Company plans to install an electric power plant in connection with a proposed local cotton ginning mill.

BATON ROUGE, LA.—The City Council is considering the installation of an ornamental lighting system in the business district.

DONALDSONVILLE, LA. — Extensions and improvements to the municipal electric power plant and waterworks, to cost about $70,000, are under consideration.

CARTER, OKLA.—Bids will be received by G. C. Mitchell, city clerk, until April 27 for construction of an electrical distribution system, including the erection of 18 miles of transmission line, and step-down transformer station. The cost is estimated at $25,000. V. V. Long, Colcord Building, Oklahoma City, is engineer.

MADILL, OKLA.—The Consumers Light & Power Company, Ardmore, plans to erect a transmission line from Ardmore to Madill via Mansville.

NEWKIRK, OKLA. — Bonds to the amount of $115,000 have been voted for extension to waterworks, including pipe line, new well, motor-driven pumps, transmission line, etc. F. B. King, Grain Exchange Building, Oklahoma City, is engineer.

GOOSE CREEK, TEX. — The Houston (Tex.) Lighting & Power Company has acquired the system of the Goose Creek Light & Power Company and will build a transmission line to Goose Creek, Seabrook, La Porte and vicinity.

HOUSTON, TEX.—Bids will be received by H. L. Washburn, Harris County Auditor, until April 29, for equipment for power plant at the Harris County School for Boys, including one 30-hp. engine, 14-kw. generator, storage batteries, starting motors, switchboard, air compressors, etc. H. F. Jones & Tabor, and R. D. Steele, First National Bank Building, are associated architects.

SILVERTON, TEX.—The Texas Utilities Company, Plainview, plans to erect a transmission line from Plainview for local service.

Pacific and Mountain States

MOUNT VERNON, WASH.—The Puget Sound Power & Light Company, Seattle, has authorized the construction of a 6,000-volt transmission line from Bellingham.

OROVILLE, WASH. — The Okanogan (Wash.) Light & Power Company, Okanogan, plans to build a 20,000-hp. hydro-electric power plant in connection with an irrigation project in this section, to cost about $350,000. D. J. Broderick is engineer.

TACOMA, WASH.—The City Council is considering an ordinance calling for changes and additions to the municipal distribution system, the purchase of a synchronous condenser to be installed in the Nisqually substation to provide for the use of the power from the Cushman plant. The cost is estimated at about $100,000.

TACOMA, WASH.—The City Council has adopted a resolution providing for the installation of ornamental lighting systems on Jefferson Avenue, North Fourteenth Street and Ridgewood Avenue. The Council is also considering a petition for an improved lighting system in the vicinity of Forty-eighth, M and Wilkeson Streets.

REDONDO BEACH, CAL.—Bids will be received by the City Council until May 4 for the installation of an ornamental lighting system on Beryl Street, between Maria and Hermosa Avenues, and on other streets. About 300 cast-iron standards will be required.

REDWOOD CITY, CAL. — Application has been made to the Supervisors of San Mateo County by the Great Western Power Company for a franchise to erect a transmission line from the northern border of the county to the Pigeon Point lighthouse, with lines branching off on all principal roads and streets.

SAN FRANCISCO, CAL.—Work will soon begin on the construction of a hydro-electric plant, to cost $8,500,000, the first of six units, on the middle fork of the Feather River, in Butte County, by the Feather River Power Company. A dam will be built at Buck's Creek, which will impound 103,000 acre-feet of water. An 8-ft. x 7-ft. tunnel 26,000 ft. long will carry water from the dam to power house. The pressure pipe and penstocks will be about 5,000 ft. long. The effective head will be about 2,400 ft. and the plant will develop about 50,000 hp. Plans have been drawn for five other units, which will produce about 400,000 hp., to cost from $45,000,000 to $50,000,000. Lars Jorgensen, Hobart Building, San Francisco, engineer, is interested in the project.

PHOENIX, ARIZ.—The Salt River Valley Water Users' Association has voted to issue $450,000 in bonds to provide additional pumping facilities for the Salt River project.

COLORADO SPRINGS, COL.—Plans are under way by the Golden Cycle Milling & Reduction Company for the construction of a 1,500-kw. steam plant at its local mill, to cost about $75,000. The plant will be equipped with automatic stokers.

Electrical Patents

Announced by U. S. Patent Office

(Issued March 24, 1925)

1,530,699. PRIMARY BATTERY; J. G. Ross, Waterbury, Conn., and M. L. Martus, Woodbury, Conn. App. filed March 10, 1922. Gives advance indication of its degree of consumption.

1,530,712. TRAFFIC-SIGNAL DEVICE; L. S. Carleton and R. G. Carleton, Davenport, Iowa. App. filed Dec. 20, 1921.

1,530,721. LIGHTNING ARRESTER; L. C. Hart, Cleveland, Ohio. App. filed June 2, 1921.

1,530,730. ELECTRIC SWITCH; H. L. Leeb, South Orange, N. J. App. filed Sept. 17, 1921. Safety switch for electric heating devices.

1,530,828. HOUSING FOR RECEPTACLES FOR SURFACE MOUNTING; W. A. Harvey, Scranton, Pa. App. filed Dec. 8, 1922.

1,530,847. ROTARY ELECTRICAL HAND SWITCH; A. H. Mollik, Frankfort-on-the-Main, Germany. App. filed May 16, 1922.

1,530,856. BURGLAR AND FIRE ALARM; G. Schmidt, Berlin-Reinickendorf, Germany. App. filed March 4, 1920.

1,530,862. ELECTRIC ILLUMINATING DEVICE; T. J. Thompson, Chicago, Ill. App. filed June 9, 1924. Dry-cell type; for insertion into receptacles in cleaning them.

1,530,914. ELECTRIC GAS IGNITER; J. H. Roden, Toronto, Ontario, Canada. App. filed Sept. 8, 1923.

1,530,928. PROCESS FOR MAKING PACKS FOR ELECTRICAL HEATING UNITS; W. A. Braun, Dover, Ohio. App. filed Jan. 5, 1923.

1,530,929. THERMALLY CONTROLLED SWITCH; J. E. Brobst, Schenectady, N. Y. App. filed Aug. 11, 1922. Automatic reset.

1,530,934. CONTROL OF DYNAMO-ELECTRIC MACHINES; R. D. Given, Leamington, England, and H. W. Conway Liddiard, Rugby, England. App. filed June 5, 1923. Modified Ward Leonard control.

1,530,937. RADIOSCOPIC AND RADIOGRAPHIC APPARATUS SUPPRESSING THE EFFECT OF SECONDARY RAYS; L. E. Gunther, Paris, France. App. filed Sept. 3, 1921.

1,530,943. SYSTEM OF DISTRIBUTION; A. W. Hull, Schenectady, N. Y. App. filed Nov. 9, 1921. Using a magnetron.

1,530,944. CONNECTOR FOR ELECTRIC CONDUCTORS; W. C. Hunt, Toronto, Ontario, Canada. App. filed June 20, 1923. Solderless.

1,530,962. PROTECTION OF ELECTRIC SYSTEMS; O. C. Traver, Schenectady, N. Y. App. filed June 16, 1924.

1,530,963. ELECTROMAGNETIC SWITCH; J. F. Tritle, Schenectady, N. Y. App. filed Nov. 18, 1920. Shock-proof.

1,530,968. RECORDING DEVICE; S. B. Williams, Jr., Brooklyn, N. Y. App. filed April 22, 1922. For use in telephone exchange systems.

1,530,981. SYSTEM OF SPACE DISCHARGE DEVICES; O. O. Ceccarini, Mahwah, N. J. App. filed Jan. 25, 1924. Arrangement including tandem-connected three-electrode devices.

1,530,986. AUTOMATIC TELEPHONE SWITCH; H. F. Dobbin, New York, N. Y. App. filed June 16, 1923. Co-ordinate switch.

1,530,988. TESTING VACUUM TUBES; H. W. Everitt, Springfield Gardens, N. Y. App. filed Nov. 6, 1920.

1,530,989. MOTOR-CONTROL SYSTEM; H. Fitzhugh Farmer and H. Dreghorn, Rugby, England. App. filed Aug. 4, 1923. For the control of alternating-current commutator motors when used for driving printing presses and similar machines.

1,530,993. LIGHTING FIXTURE; H. A. Framburg, Berwyn, Ill. App. filed April 30, 1921.

1,530,996. TELEPHONE SWITCH; E. W. Gent, Morristown, N. J. App. filed Oct. 24, 1922. Co-ordinate switch.

1,530,998. AUTOMATIC TELEPHONE SWITCH; H. W. Goff, New York, N. Y. App. filed July 3, 1922. Co-ordinate switch.

1,530,999. TELEPHONE SWITCH; C. L. Goodrum, New York, N. Y. App. filed May 7, 1923. Adapted for establishing connections in an automatic or semi-automatic telephone system.

1,531,006. TELEPHONE SYSTEM; E. E. Hinrichsen, New York, N. Y. App. filed Jan. 13, 1921. Machine switching.

1,531,016. ELECTRICAL SWITCHING DEVICE; H. T. Martin, New York, N. Y. App. filed Dec. 6, 1920. Plug switch.

1,531,025. TELEPHONE-EXCHANGE SYSTEM; L. Polinkowsky, Antwerp, Belgium. App. filed Nov. 17, 1119. Machine switching.

1,531,029. RADIO TRANSMISSION SYSTEM; F. M. Ryan, East Orange, N. J. App. filed Aug. 24, 1921.

1,531,036. GLOW LAMP; F. Skaupy, Berlin, Germany. App. filed Dec. 11, 1922. Adapted for use in signs.

1,531,046. TELEPHONE-EXCHANGE SYSTEM; D. L. Temple, New York, N. Y. App. filed Oct. 23, 1922. For observing and testing automatic equipment.

1,531,048. TELEPHONE-EXCHANGE SYSTEM; G. Thompson, Mount Vernon, N. Y. App. filed Feb. 9, 1924. Automatic.

1,531,049. ELECTRICAL CONNECTION CLIP; H. G. Thompson, Cleveland, Ohio. App. filed June 13, 1923.

1,531,080. TELEPHONE-EXCHANGE SYSTEM; W. L. Dodge, Maplewood, N. J. App. filed July 2, 1921. Machine switching.

1,531,134, 1,531,135. AUTOMATIC TELEPHONE SWITCH; C. D. Richard, West New Brighton, N. Y. App. filed June 27, 1922. Co-ordinate switch.

1,531,136. ELECTRIC GROUP KETTLE; J. La Rue Robinson, Reno, Nev. App. filed Sept. 15, 1923.

1,531,138. UNIVERSAL CONTACT BAR FOR ELECTRIC CIRCUITS; F. Satterstrom, Hastings, Minn. App. filed Oct. 29, 1920. For use in connection with a series of electric circuits such as are provided with electrically actuated typewriters.

1,531,140. METHOD OF FORMING ELECTRODEPOSITS; G. Schneider, La Vale, Md. App. filed Jan. 19, 1924.

1,531,152. CONDUIT TERMINAL BOX; C. W. Steen, Norwood, Ohio. App. filed March 24, 1920. For application on motors, etc.

1,531,196. APPARATUS FOR PRODUCING COLD ELECTRIC DISCHARGES; J. Kuhlenschmidt, Berlin - Hohenschonhausen, Germany. App. filed July 28, 1924.

1,531,203. WIRELESS SYSTEM; C. Lundquist, Winfield, Iowa. App. filed July 25, 1922. For transmitting telegraphic signals on wireless telephone circuits.

7,531,218, 1,531,219, 1,531,220. AUTOMATIC TELEPHONE SYSTEM; W. T. Powell, Rochester, N. Y. App. filed Sept. 18, 1922.

1,531,221. AUTOMATIC TELEPHONE SYSTEM; W. T. Powell, Rochester, N. Y. App. filed Feb. 8, 1923.

1,531,240. THREE-WIRE-SYSTEM REGULATION; H. B. Marshall, St. Louis, Mo. App. filed June 11, 1923. Limiting the voltage on one side of the neutral wire to a predetermined maximum.

1,531,252. ELECTRICAL REPRODUCER FOR PHONOGRAPH RECORDS; E. T. Jones, New Orleans, La. App. filed Nov. 25, 1921.

1,531,265. SEALED-IN CONDUCTOR; P. K. Devers, Lynn, Mass. App. filed Aug. 3, 1921. Suitable for use with vessels of fused silica.

(Issued March 31, 1925)

1,531,301. LUMINOUS VESSEL; F. J. Metzger, New York, N. Y. App. filed Nov. 17,1922. Gas-filled luminous container.

1,531,302. ELECTROMAGNETIC SWITCH FOR BURGLAR-ALARM SYSTEMS; C. B. Miles, Toledo, Ohio. App. filed Sept. 21, 1923.

1,531,308. ELECTRIC HEATER; A. S. Rice and L. J. Fuller, Brooklyn, N. Y. App. filed Feb. 1, 1923. Ribbed surface plate to give uniform heat.

1,531,309. SECTIONAL SWITCH BOX; A. Ryden, Chicago, Ill. App. filed July 15, 1922.

1,531,312. ELECTRODE; E. Schlumberger, Berlin, Germany. App. filed Aug. 31, 1921. Coke galvanized with metal to activate hydrogen.

1,531,347. RELAY; W. A. Rhodes, Kansas City, Mo. App. filed April 25, 1922. Spring contacts at points least affected by vibration.

1,531,370. CURRENT-GENERATING PLANT; F. G. Beavers, Americus, Ga. App. filed Mar. 17, 1923. Windmill type.

1,531,378. CONTROLLER FOR OSCILLATION GENERATORS; G. H. Clark, Brooklyn, N. Y. App. filed Feb. 16, 1921.

1,531,386. ELECTROLYTIC PROCESS; H. Gerdien, Berlin-Grunewald, Germany. App. filed Jan. 3, 1924. Current density increased in electrolyte without temperature increase.

1,531,411. GROUND CLAMP; C. V. Perry, West Haven, Conn. App. filed Mar. 15, 1924.

1,531,417. PLATING APPARATUS; L. Schulte, Chicago, Ill. App. filed Nov. 30, 1923. Having a movable carrier for the articles to be plated.

1,531,423. SUPPORT FOR ELECTRIC FIXTURES; W. S. Simpson, Niagara Falls, Ontario, Canada. App. filed Oct. 26, 1921. Outlet-box support.

1,531,447. MANUFACTURE OF LAMINATED METAL OR OTHER MASSES; A. H. Midgley, Uxbridge, England. App. filed April 3, 1922. For pole pieces of dynamo-electric machines.

1,531,494. NON-GROUNDED OR METALLIC CIRCUIT SYSTEM; E. A. Mellinger, Chicago, Ill. App. filed April 18, 1907. Telephone system.

1,531,515. ELECTRIC HEATER; L. Simmons, Washington, D. C. App. filed April 18, 1923. Combined heating coil and fan or blower.

1,531,516. ELECTRIC HEATING MACHINE; L. Simmons, Washington, D. C. App. filed Oct. 4, 1923. Air-draft tunnel heated by electric glow heating resistance.

1,531,517. ELECTRICAL COOKER; L. Simmons, Washington, D. C. App. filed Nov. 5, 1923. With rotary grill or disk in oven.

1,531,518. ELECTRICAL HEATING APPLIANCE; L. Simmons, Washington, D. C. App. filed Nov. 17, 1923. Air-heating throat for the passage of air.

1,531,519. PORTABLE ELECTRIC AIR HEATER AND CIRCULATOR; L. Simmons, Washington, D. C. App. filed April 24, 1924. For small rooms.

1,531,520. ELECTRIC HEATER; L. Simmons, Washington, D. C. App. filed July 15, 1924. Forced-air type; in ornamental cabinet.

1,531,522. INSULATED VENTILATING CONNECTOR; L. Steinberger, Brooklyn, N. Y. App. filed Oct. 12, 1918.

1,531,527. ELECTRIC MOTOR; R. R. Thompson (deceased), by M. W. Thompson, executrix, Los Angeles, Cal. App. filed Nov. 22, 1919. For signal systems.

1,531,528. GAUGING DEPTHS IN AN ELECTROLYTIC CELL; D. H. Tilson, Badin, N. C. App. filed Jan. 16, 1924.

1,531,592. SPEED-REGULATOR SYSTEM; C. A. Boddie, Pittsburgh, Pa. App. filed March 11, 1919.

1,531,595. COMMUTATOR; L. G. Chaix and E. L. Chaix, San Francisco, Cal. App. filed April 24, 1923. Rectifying commutator which is driven at a synchronous speed.

1,531,596. CIRCUIT INTERRUPTER; A. W. Copley, Wilkinsburg, Pa. App. filed April 23, 1920. For use on alternating-current circuits.

1,531,601. ELECTRICAL PROTECTIVE DEVICE; R. D. Evans, Pittsburgh, Pa. App. filed Nov. 5, 1920. For dynamo-electric machines.

1,531,604. ATTACHMENT PLUG; A. C. Gaynor, Stratford, Conn. App. filed June 3, 1921. To prevent strain on conductors and contacts.

1,531,605. PUSH-BUTTON; A. C. Gaynor, Stratford, Conn. App. filed Jan. 19, 1924. For electric bell circuits.

1,531,606. WAVE-SIGNALING-CONTROL SYSTEM; A. H. Grebe, Richmond Hill, N. Y. App. filed Sept. 4, 1920.

1,531,611. ELECTRICAL PROTECTIVE SYSTEM; R. E. Hellmund, Swissvale, Pa. App. filed Nov. 12, 1920. Protection of transformer windings.

1,531,618. POROUS COPPER POLE FOR CELLS; S. Kotera, Tokyo, Japan. App. filed June 12, 1923.

1,531,620. PENETROMETER FOR X RAYS; W. H. Meyer, Tuckahoe, N. Y. App. filed June 5, 1922.

1,531,629. APPARATUS FOR ELECTRICAL SIGNALING; G. O. Squier, Washington, D. C. App. filed Aug. 6, 1920. Operates on open-circuit principle.

1,531,633. OSCILLATION GENERATOR; H. J. Vennes, New York, N. Y. App. filed Dec. 22, 1920. Vacuum-tube type.

1,531,654. ALTERNATING-CURRENT MOTOR-CONTROL SYSTEM AND CONTROL SWITCH THEREFOR; W. J. Hudson, Muscatine, Ia. App. filed Jan. 25, 1919.

1,531,662. STRAIN INSULATOR; W. H. Kempton, Wilkinsburg, Pa. App. filed Oct. 17, 1918.

1,531,667. CIRCUIT INTERRUPTER; J. W. Legg, Wilkinsburg, Pa. App. filed Dec. 16, 1920. Horn-gap type.

1,531,668. ELECTRIC ARC CONTROL; J. W. Legg, Wilkinsburg, Pa. App. filed Dec. 21, 1920.

1,531,669. ELECTRICAL PROTECTIVE DEVICE; S. G. Leonard, Wilkinsburg, Pa. App. filed Nov. 30, 1920. For protecting polyphase translating apparatus.

1,531,671. ELECTRIC HEATING UNIT; W. C. Lindemann, Milwaukee, Wis. App. filed April 22, 1922. Single-piece plate and element to give uniform heat over surface.

1,531,722. TIME-LIMIT OVERLOAD RELAY FOR ELECTRIC CIRCUITS; F. O. Adams, Toronto, Ontario, Canada. App. filed Oct. 31, 1921.

1,531,724. ELECTRIC MACHINE; A. Arutunoff, Berlin, Germany. App. filed April 18, 1921. With forced lubrication.

1,531,756. FUSE; L. F. Roach and M. F. Wolfe, South Milwaukee, Wis. App. filed April 18, 1922. A glass tube having a chamber partially filled with mercury into which rods project, the rods extending to contacts.

1,531,799. DEMOUNTABLE MOTOR; E. Lux, San Diego, Cal. App. filed June 5, 1922. Toy motor.

1,531,801. SIGNALING SYSTEM; D. G. McCaa, Palo Alto, Cal. App. filed May 2, 1922. Eliminating disturbing electrical effects.

Financial and Corporate

Utility Stocks Irregular

Advances Outnumber Declines in Market That Has Moderate Volume

ALTHOUGH trading in the unlisted market for power and light stocks during the past week revealed a mixture of net gains and losses, the gains somewhat outnumbered the losses. The market has been better in spots, but does not yet show the buoyancy that characterized its movement at many periods last year. It is only natural that fluctuations should be smaller than at the time stocks were first coming into their investment prominence. The lethargy of the general securities market has also, of course, influenced to a considerable extent the utility issues.

A tabulation of the price changes for individual stocks during the week reveals no very striking advances or declines. The net change for the week did not run above three points in many instances. Buying has been especially heavy of late in the stock of the new utility formed to take over the Utah Securities group, namely, Electric Power & Light. The stock, which is the member of the Electric Bond & Share family now receiving most attention in the market perhaps, rose to new high levels during the week. Stock broke new high ground above 18, an advance of about four points for the week.

Among the old leaders that improved their position by a small amount were American Power & Light, Commonwealth Power Corporation and Electric Bond & Share Securities Corporation. Each of these stocks improved its position by approximately three points. Trading was active in the Northern Ohio Power stock, which sold around 8, or at a new high level. On the other hand, substantial declines were recorded for such prominent issues as Lehigh Power Securities, National Power & Light and Power Corporation of New York.

New Capital Issues

The Columbia Gas & Electric Company during the past week floated a ten-million-dollar issue of 5 per cent gold notes at 100 and interest, to yield 5 per cent. The proceeds of these notes, dated May 1, 1925, and maturing May 1, 1928, are to be applied partly for capital expenditures, chiefly to complete the construction of the new 80,000-kw. Miami Fort electric generating station, and partly for reimbursement of the cash portion of the purchase price of virtually all of the common stock of the Dayton Power & Light Company.

Ten-year debenture gold bonds were offered to the investing public by the Columbus, Delaware & Marion Electric Company to the amount of $1,250,000. These series A bonds are convertible into the common stock.

The Mountain States Power Company was represented with a two-million-dollar issue of first mortgage bonds and the Binghamton Light, Heat & Power Company with a million-and-a-half-dollar issue of first refunding mortgage gold bonds.

The Electrical Securities Corporation, a subsidiary of the General Electric Company, owning bonds of various public utility companies, issued collateral trust sinking-fund 5 per cent bonds amounting to $1,000,000.

The Interstate Electric Corporation was represented with a small additional issue of first lien 6 per cent sinking-fund gold bonds totaling $500,000.

Company Reports

The following reports were made during the past week by electric light and power companies for the month of March:

Name of Company	Gross Earnings for March 1925	1924
Adirondack Power & Light	$668,304	$628,281
Alabama Power	805,717	721,366
Associated Gas & Electric *	809,241	300,333
Cities Service	1,922,141	1,823,418
Columbia Gas & Electric	2,504,618	2,967,784
Detroit Edison †	3,330,060	3,168,130
Massachusetts Lighting	278,512	271,001

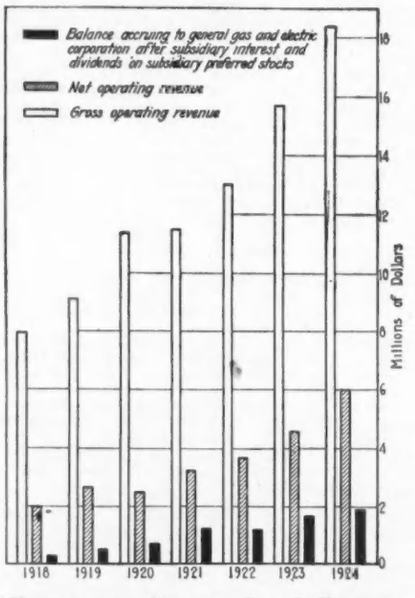
*February.
†Includes other revenue.

General Gas & Electric Corporation

Operating Revenues of This Utility, Which Now Controls About Fifty Properties, Have Reached a Total of More than $19,000,000 Annually

BY PAUL WILLARD GARRETT

INCORPORATED under the laws of Maine in 1922, the General Gas & Electric Corporation acquired all of the assets and assumed all of the liabilities of the General Gas & Electric Company. Expansion has been marked in more recent years, although the corporation has not hesitated to sell properties, as well as to purchase them, when in deals of that description advantages for the organizations have been promised. Something like fifty public utility companies now are controlled by the corporation through stock ownership, leases or otherwise, the more important properties being in the eastern and southeastern section of the United States.



EARNINGS OF GENERAL GAS & ELECTRIC CORPORATION ADVANCE CONSISTENTLY

The General Gas & Electric Corporation has plants and distribution systems in eight states—Pennsylvania, New Jersey, New York, Vermont, New Hampshire, North Carolina, South Carolina and Florida. A few of the better known companies in the system are the Metropolitan Edison Company, a subsidiary system which in itself contributes more than $8,000,000 annually of the total $19,000,000 in gross revenues; Pennsylvania Edison Company, Reading Transit & Light Company and the New Jersey Power & Light Company.

While the word "gas" occupies a conspicuous place in the company's name, it does not, as things now are organized, represent nearly so important a part of its activities as might appear. The properties under control primarily are power and light enterprises, approximately 75 per cent of the gross revenues originating from services of that description.

EXTENSIVE SUPERPOWER SYSTEM

The interconnection of the subsidiaries operating in Pennsylvania and New Jersey forms a unified power system that is larger than might be supposed. It covers the important industrial section between Dover, N. J., within 30 miles of New York City, and the section in Pennsylvania around Harrisburg and York. Important centers covered by the transmission lines are the Easton, Reading, Lebanon and Hanover districts.

Earnings of the General Gas & Electric Corporation have been stepping up until greater and greater values have been created for the different security issues. Gross revenues for the year ended February 28, 1925, reached a total of $19,299,955. Operating expenses and taxes totaled $9,342,939, and for maintenance and depreciation $3,565,637 was set aside. Income available for fixed charges thus was

$6,501,701, or enough to cover by a wide margin the charges of $3,579,704.

The total funded debt of the General Gas & Electric Corporation is $5,097,650, but following the bonds come four classes of capital stock, three representing preferred and one common stock. Of the preferred stock the 62,650 shares of cumulative preferred class A stock are the most important from the standpoint of size. The corporation has 22,500 shares of cumulative class B stock, 40,259 shares of convertible preferred stock and 45,274 shares of common. The A and B stocks are preferred over all other stocks in liquidation or dissolution. The A stock also carries a participating privilege in that after payment in any calendar year of all dividends provided for the preferred stocks and of $6 on the common any additional amounts declared in that year shall be divided among the stock of each class then outstanding.

Annual Reports of Electric Light and Power Companies

The annual report of Cities Service Company for 1924, which has just been issued, shows an increase in net earnings from $16,093,616 to $16,773,744. After interest charges this was the equivalent of 2.90 times the preferred dividend, as against 2.70 times in the year before, and net to common stock and reserves was $9,736,077, which was the equivalent of $21.14 a share on the common stock, as compared with $18.28 a share in 1923. The itemized and explanatory consolidated balance sheet of Cities Service Company and its subsidiaries shows the total current assets amounting to $57,408,803, as compared with $50,994,825 in 1923. Total current liabilities are shown in the consolidated balance sheet at $28,260,866, as compared with $24,066,151 in 1923. During the year the electric properties of the company produced and sold 1,004,181,394 kw.-hr. of electrical energy, as compared with 993,913,613 kw.-hr. in 1923.

The report shows that the customer-ownership division of Cities Service Company and its subsidiaries distributed more than $23,442,000 par value securities to more than 36,500 customers and employees, while the new-business departments of the public utility properties of Cities Service Company sold more than $5,630,000 of appliances during the year to customers, as compared with $4,800,000 in 1923.

In its forty-third annual report for the fiscal year ended December 31, 1924, the United Gas Improvement Company reports total earnings of $9,562,443, as compared with $8,501,423 for the previous year. Net profits for the year amounted to $8,097,256, against $6,433,956, an increase of $1,663,300.

The Illinois Power & Light Corporation in its annual report for 1924 reports gross earnings of $29,184,288, as compared with $27,930,854 for the year 1923. Operating and maintenance expenses, including taxes, amounted to $19,576,322, leaving a total net of $9,607,966. In rendering service to its customers there was generated in 1924 in the company's plants 476,594,000 kw.-hr. of electrical energy compared with 219,626,000 kw.-hr. in 1916, or an increase of 117 per cent in eight years. During this same period the number of electric meters increased from 93,738 to 210,010, a gain of 124 per cent. In addition to the 9,140 customer-owner stockholders on December 31, 1924, there were 4,762 more persons who are acquiring the stock on the partial-payment plan and will soon be added to the list.

Gross earnings of the Central Illinois Light Company, as recorded in the annual report for 1924, totaled $3,603,180, against $3,520,535 in 1923. Net income available for dividends, replacements and depreciation amounted to $1,080,775, as compared with $992,077 during the previous year. Electric sales in kilowatt-hours fell from 89,467,309 in 1923 to 84,413,744 in 1924, owing to the general slowing up of industrial activities during the summer. New electric customers numbering 2,446 were added in 1924, bringing the total served as of December 31, 1924, up to 33,699. The company expended $751,159 during the year for improvements and extensions.

The Southern Indiana Gas & Electric Company in the annual report for 1924 just issued reports gross earnings of $2,654,615, compared with $2,578,764 in 1923. Net income available for dividends and depreciation amounted to $586,020, leaving a balance after dividends on preferred of $368,483, against $329,610 in the previous year. Sales in kilowatt-hours for the year amounted to 36,428,606, an increase of 1,579,046 over the high record in 1923 and nearly double the sales in 1919. The increased sales of the electric department were accompanied by a gain of 2,199 electric customers, bringing the total at the end of the year up to 18,978. The company expended $492,348 during the year for improvements and extensions.

The annual report of the Northern Ohio Traction & Light Company for the year 1924 shows gross earnings of $5,364,189 and gross income after operating expenses and taxes of $2,177,564. These figures compare with gross earnings of $5,849,877 in 1923 and gross income of $2,339,529. The electric department established a new high record in 1924 by increasing its sales to 176,245,654 kw.-hr., the gain being accompanied by an increase of 3,188 electric customers. Expenditures amounting to $2,124,675 were made for improvements and extensions.

The Republic Railway & Light Company and subsidiary companies in a condensed comparison of the years 1924 and 1923 show gross income of $10,546,268, against $9,935,925, and net earnings after operating expenses and taxes of $3,552,635, compared with $3,280,372. Substantial additions and extensions were made to the company's properties during 1924, necessitating an expenditure of over $10,000,000. The number of electric customers increased from 59,101 to 68,801.

Public Service Corporation to Conduct Another Campaign.—Another customer-ownership campaign will be opened by the Public Service Corporation of New Jersey on May 1, when the sale of 7 per cent cumulative preferred stock through employees will begin.

Dividends Declared

The following quarterly dividends were announced by electric light and power companies during the past week:

Name of Company	Per Cent	When Payable
Cities Service, com.†	½	June 1
Cities Service, com†	½*	June 1
Cities Service, pf. and prefer. B†	½	June 1
Columbia Gas & Electric, com	65c	May 15
Columbia Gas & Electric, pf	$1.75	May 15
Dallas Power & Light, pf	1¾	May 1
Knoxville Power & Light, pf	$1.75	May 1
National Power & Light, com	$1.50	June 1
Pacific Power & Light, pf	1¾	May 1
Quebec Power, com	$1.25	May 1
Wisconsin River Power. 7% cum. pf.	$1.75	May 20

* In common stock. †Monthly.

A. T. & T. Stock Increase Authorized.—The stockholders of the American Telephone & Telegraph Company have approved the recommendation of the directors to increase the authorized capital stock from $1,000,000,000 to $1,500,000,000.

Securities Called in April.—Three issues of Oklahoma Gas & Electric Company's securities have been called for payment in April in advance of maturity—5 per cent bonds totaling $2,788,000, 6 per cent notes totaling $2,000,000 and 7 per cent notes totaling $2,100,000. Among the other bond issues called are the following: Montreal Tramway & Power 6's of 1929, amounting to $8,000,000; United States Public Service second series 6's of 1947, amounting to $1,100,000; Central Illinois Light 7½'s of 1943, amounting to $1,053,000; North Coast Power 6's, 1941, amounting to $661,000; Cedar Valley Electric 6's, 1935, totaling $400,000, and Binghamton Light, Heat & Power 5's of 1942, totaling $111,000.

Listings.—The New York Stock Exchange has recently authorized the listing of $9,159,000 additional cumulative 7 per cent preferred stock, series A, par $100, an official notice of issuance and payment in full, making the total amount listed and applied for $24,159,000. Also authorized was the listing of $7,000,000 general mortgage twenty-five-year 7 per cent gold bonds, series B, and $4,000,000 general mortgage twenty-five-year 5½ per cent gold bonds, series C, of the Rochester Gas & Electric Corporation. The listing of 6 per cent cumulative preferred stock, 1925 series, of the Public Service Electric & Gas Company to the amount of $15,000,000 has been authorized.

Refrigerator Company Offers Stock.—The Nizer Corporation of Detroit offered last week 50,000 shares of convertible participating class A stock at $35 per share and accrued dividends to yield 8.57 per cent. The Nizer Corporation has been organized in Maryland to acquire the business of the Nizer Corporation, a Michigan corporation formed in 1922 to manufacture and market the Nizer automatic electric refrigerator cabinet, and the business of the Nizer Laboratory Company, also a Michigan corporation, which owns the entire outstanding common stock of the Nizer Corporation (of Michigan). Proceeds are to be used to retire $205,800 8 per cent cumulative preferred stock of the Nizer Corporation of Michigan and for other corporate purposes.

Stock and Bond Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stocks is $100.)

Companies	Bid Price Saturday, April 18	Low 1925	High 1925
PREFERRED STOCKS			
Operating Companies			
Adirondack Power & Light 7 per cent	99	98	102
Appalachian Power, 7 per cent	97½	92	100
Arkansas Light & Power 7 per cent	93	92	98
Asheville Power & Light 7 per cent	a 99	99	100
Central Illinois Public Service 6 per cent	90	84	93
Colorado Power 7 per cent	94	93	98
Connecticut Light & Power 7 per cent	106	105	110
Consumers' Power 6 per cent	91½	90	93½
Dayton Power & Light 6 per cent	92	88	100
Duquesne Light 7 per cent	a107	105	107½
Eastern Texas Electric 6 per cent	100	100	105
Empire District Electric 6 per cent	78	78	85
Fort Worth Power & Light 7 per cent	a101	100	102
Great Western Power 7 per cent	98		
Illinois Northern Utilities 6 per cent	88	82	92
Illinois Power & Light 7 per cent	94	92½	98
Kansas Gas & Electric 7 per cent	a 98	98	100
Long Island Lighting 7 per cent	101	100	105
Minnesota Power & Light 7 per cent	a 96	96	98
Mississippi River Power 6 per cent	90	87½	92
Nebraska Power 7 per cent	a 98	98	100
Niagara Falls Power 7 per cent—25	28⅜	28	29
Niagara, Lockport & Ont. Power 7 per cent	105½	101½	110
Northern States Power 7 per cent	96	95	100
Ohio Public Service 7 per cent	97	97	100
Pacific Gas & Electric 6 per cent	94½	92	97
Pacific Power & Light 7 per cent	a 98	98	100
Penn-Ohio Power & Light 7 per cent	94	91	100
Pennsylvania Power & Light $7—no par	a101	100	101½
Penn. Public Service 7 per cent	90	90	100
‡Philadelphia Electric 8 per cent—25	37½	37½	45
Southern California Edison 8 per cent	118	115	122
Tennessee Electric Power, 6 per cent	81	80	84
Texas Power & Light 7 per cent	a100	100	101
Utah Power & Light 7 per cent	99	98½	99½
Western States Gas & Electric 7 per cent	89	82	89
Yadkin River Power, 7 per cent	a 99	98	100
Holding Companies			
American Gas & Electric 6 per cent—100	84	84	89
American Light & Traction	95½	93	97
American Power & Light 6 per cent	85	84	90
American Public Service 7 per cent	91	88	94
American Public Utilities 7 per cent	88	87	95
American Water Works & Electric 7 per cent	a101½	100	103
Associated Gas & Electric 7 per cent—1 per cent extra—no par	a 52		
Carolina Power & Light 7 per cent	101	100	105
Central Indiana Power 7 per cent	89	88	95
Cities Service 6 per cent	81	80	83
Commonwealth Power 6 per cent	81½	80	82½
Consolidated Gas 6 per cent—50	58½	57½	59
Continental Gas & Electric 7 per cent pr. pf	90	89	95
Electric Bond & Share 6 per cent	102½	102	104
General Gas & Electric—$8—no par	109	104½	111
*Middle West Utilities 7 per cent	96	91½	98⅜
National Power & Light—$7—no par	95½	95	99
North American 6 per cent—50	a 48⅜	46½	49
Public Service Corp. of N. J. 7 per cent	a101½	99	102
Public Service Corp. of N. J. 8 per cent	a109	109	112½
Standard Gas & Electric 8 per cent—50	a 51½	50½	53¾
‡United Gas Improvement—50	57½	56⅜	58½
United Light & Power—$6.50—no par	81	81	88
COMMON STOCKS			
Operating Companies			
Adirondack Power & Light—50	55	31	55
Appalachian Power—no par	77	70	83
Arkansas Light & Power	75	65	85
Brooklyn Edison	a129½	120½	133
Buffalo General Electric—no par (new)	51	44	51½
*Commonwealth Edison	133	132½	139
§Consolidated Gas, Electric Light & Power	35	32	35¼
Dayton Power & Light	420	180	460
Detroit Edison	a115½	110	119
|| Edison Electric Illuminating of Boston	203½	200	206
Kentucky Hydro-Electric	91	85½	92½
Long Island Lighting (new)	84	60	85
Mississippi River Power	39	37	42
Montana Power	a 65	64	72
Niagara Falls Power—no par	57	45½	58
Niagara, Lockport & Ontario Power—no par	60	60	73
Northern Ohio Power	6½	5	7½
Northern States Power	108	103	110
North Texas Electric	60	60	70
Pacific Gas & Electric	a105	102½	108½
‡Penn Central Light & Power—no par	a105	60	64½
§Pennsylvania Water & Power	129½	126½	133½
‡Philadelphia Electric—25	38¼	37⅜	45⅜
Public Service Co. of Northern Illinois	114	97	116
Puget Sound Power & Light	49	49	58
Southern California Edison	106½	102	107½
Tennessee Electric Power—no par	60	47	61
Virginia Power	60	60	92
Virginia Railway & Power	a 91½	64½	92½
West Penn. Co.	115	105	120

Companies	Bid Price Saturday, April 18	Low 1925	High 1925
Holding Companies			
American Gas & Electric—no par	73	70	80
American Light & Traction	140	139	153
American Power & Light	56	52	67
American Public Utilities	74	70	85
American Water Works & Electric	a 45⅞	34½	49
Associated Gas & Electric, Class A	a 28⅜		
Carolina Power & Light—no par	330	290	350
Cities Service (new)	35	34	43
Columbia Gas & Electric—no par	a 56⅜	45⅜	59
Commonwealth Power Corp.—no par	113	106	126
Consolidated Gas—no par	a 77⅞	74⅛	78⅝
Continental Gas & Electric	77	77	90
Electric Power & Light	18	15	19⅛
Federal Light and Traction	139½	114½	148½
General Gas & Electric	78	72	82
Lehigh Power Securities—no par	106	82	116
*Middle West Utilities—no par	98½	82½	102½
National Power & Light—no par	248	185	255
North American—10	a 45⅜	41⅛	49
Philadelphia Co.—50	a 52½	51½	57¼
Power Securities—no par	12		
Public Service Corp. of N. J.—no par	a 66½	62⅜	72½
Standard Gas & Electric—no par	a 44⅜	40½	47½
United Gas & Electric (Conn.)—no par	28	26	37½
Utah Securities	a 85¼	41⅛	86½
BONDS			
Operating Companies			
Adirondack Power & Light	6s 1950	104	102½ 105
Alabama Power	5s 1946	97½	96 98
Appalachian Power	5s 1941	97	96 97½
Brooklyn Edison	5s 1949	100¼	99⅛ 100¼
	6s 1930	105⅛	104 105⅛
Cleveland Electric Illuminating	5s 1939	100½	100 101½
Commonwealth Edison	5s 1943	100¼	99½ 101
	5s 1953	99	98½ 99½
Consol. Gas, Elec. Lt. & Pwr.	4½s 1935	96½	93½ 97½
	§6s 1949	106⅛	104⅛ 106⅛
Consumers' Power	5s 1936	93	93 94½
	5s 1952	95½	90½ 95½
Detroit Edison	5s 1933	101½	99½ 102½
Duquesne Light	6s 1949	105⅛	104⅛ 107
Great Western Power	5s 1946	97	95 97½
Kansas City Power & Light	5s 1952	98½	95⅝ 98½
Mississippi River Power	5s 1951	98¼	96½ 99
Montana Power	5s 1943	99	97⅝ 99½
New England Power	5s 1951	100⅜	100⅛ 101⅛
New York Edison	6½s 1941	113½	112 115
Niagara Falls Power	6s 1932	105½	103¾ 105½
Northern States Power	5s 1941	96	93 96½
	6s 1941	103⅜	103 107½
Ohio Power	7s 1951	106½	106⅛ 107⅛
Pacific Gas & Electric	5s 1942	95¼	93½ 96
Pennsylvania Water & Power	5s 1940	100	99½ 101
‡Philadelphia Electric	5s 1966	101½	100½ 102
	5½s 1947	105½	103½ 105½
	6s 1941	107⅛	106 107⅛
Portland Electric Power	6s 1947	97⅞	94 99½
Southern California Edison	5s 1939	99	99 100⅛
	6s 1944	103½	102½ 104½
Tennessee Electric Power	6s 1947	100⅛	99½ 102½
Texas Power & Light	5s 1937	97½	97 98
Toledo Edison	7s 1941	109	108½ 110½
Utah Power & Light	5s 1944	97⅞	91 95½
Holding Companies			
Alabama Traction, Light & Power	5s 1962	89	86 90
American Gas & Electric	6s 2014	96½	96½ 97
American Power & Light	6s 2016	95	94 95½
Amer. Water Works & Electric	5s 1934	95½	92½ 96½
Associated Gas & Electric	6½s 1954	a100	
Central Indiana Power	6s 1947	97½	95½ 98½
Commonwealth Power	6s 1947	100½	97⅜ 101
Consolidated Cities Lt., Pwr. & Tr.	5s 1962	79½	75½ 80½
Illinois Power & Light	6s 1953	101	100½ 102
United Light & Railways	5s 1932	94	93½ 94½
	6s 1952	97½	95¾ 99¾
ELECTRICAL MANUFACTURING COMPANIES			
PREFERRED STOCKS			
Allis-Chalmers Manufacturing	a106	103½	107
*National Carbon	121½	120	124
Worthington Pump & Machinery A	87	79	88
COMMON STOCKS			
Allis-Chalmers Manufacturing	a 79½	71½	86½
American Bosch Magneto—no par	a 32⅜	26½	54½
Electric Storage Battery—no par	a 63⅜	60¼	70½
General Electric	a272½	227½	320
General Electric—10	a 11½	11	11½
*Hurley Machine—no par	44⅜	41½	56
†Wagner Electric	33	26½	50
Westinghouse Electric & Manufacturing—50	a 68⅜	66¼	84
Worthington Pump & Machinery	a 49¾	45	79½
BONDS			
General Electric	3½s 1942	83½	83 84
	5s 1952	105½	101½ 105½
Robbins & Myers	7s 1952	65	65 73½
Wagner Electric Mfg.	7s	101	100½ 101
Western Electric	5s 1944	100¼	98 100½
Westinghouse Electric & Mfg.	7s 1931	107¼	107½ 108½

*Chicago Stock Exchange. †St. Louis Stock Exchange. ‡Philadelphia Stock Exchange. || Boston Stock Exchange. § Baltimore Stock Exchange.
a Bid price, low and high, Tuesday, April 21.